The
# Practical Engineer

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## A TALK WITH A CHIEF ENGINEER

### Practical Points in Reference to Boiler Feeding, Firing, Sparking Commutators, Dead Generators and Pipe Covering.

BY WM. KAVANAGH.

When visiting engine and boiler rooms in other plants, many interesting facts can be picked up and, if the chief is communicative, many hours can be spent in discussing the operation of different types of machinery and the lay-out of the plant. On entering one plant, the writer had a very interesting chat with an old-time chief who gave some information that was valuable to me and may be to others.

On entering the boiler room, the chief called attention to the boiler feed pump which was of the triplex pattern, electrically operated. The speed of the pump was controlled by a variable speed rheostat of sufficient size to insure a slow or rapid operation of the pump. The motor which actuates the pump was of the four-pole type, shunt wound, and was fitted with a rawhide pinion which meshes in a larger gear that operates the three plungers. The suction and discharge valves were in such a position that little effort for renewal or inspection is required should they become inoperative from any cause.

One important point noted with this pump was the by-pass which can be adjusted as slow or rapid as desired while the speed of the pump remained constant. The adjustment of the by-pass so as to maintain a constant water level is economical because previous to the installation of the by-pass, should the pump be slowed down at the rheostat, the surplus water would overflow into the sewer and be lost as the heater is of the open type. Therefore, lessening the cold water supply to heater and adjusting the by-pass to the proper point resulted in a large saving.

There was one thing the chief didn't like about the open heater, and that was the excelsior used for filtering the feedwater, as it finds its way into the suction and discharge valve chambers, necessitating frequent cleaning of the valves and ports.

A kerosene oil feeder was attached to the feed pipe of each boiler and the oil was fed into each boiler at the rate of six drops per minute. The kerosene feeders work in exactly the same manner as cylinder lubricators. The chief was of the opinion that kerosene fed in this way was more effective than when fed in large quantities and at irregular intervals.

The fuel used at this plant consists of one part of anthracite dust and three parts of soft coal. The chief said that he could not reduce this proportion any lower and maintain the required pressure and quantity of steam. He had tried one barrow of dust to two barrows of soft coal and found that this mixture would not keep up the pressure. The dust is very effective in preventing smoke formation, but every fireman does not understand how to handle such a mixture. It is interesting to know that expert marine firemen were tried in the burning of this mixture and not one of them succeeded in firing the dust and soft coal without forming large volumes of smoke. Owing to the law imposed by the city authorities against the smoke nuisance, the chief was compelled to train his firemen how to fire this mixture so as to produce the least amount of smoke. The coking method is employed and only one side of each furnace is fired at a time, thus maintaining a high temperature on the other side.

The chief explained that after the coal was coked at the front, it was pushed back by means of the "pushing back hoe" which is a medium light hoe. The front is then filled up with the mixture to be coked, the furnace door is closed and is not opened until the other side has been pushed back and the front charged with a fresh supply. In this way the chief claims he maintains an almost smokeless furnace. This system of firing requires lots of experience before the firemen can learn the proper temperature of the furnace.

In mixing the soft coal and dust, the chief adopted the plan of having one barrow of dust dumped on top of the three barrows of soft coal and by alternating the dust and coal in the proper proportions, a sufficient quantity was made ready to last for half a day. During the dumping of the dust and coal, a stream of water was played over it, thoroughly wetting the mixture. The chief claimed that the reason why inexperienced firemen made large volumes of smoke was because they pushed back their coked coal too soon or they fired the coal too near the bridge wall, thus covering the incandescent fuel and producing smoke. The chief claimed that if the firemen fired the coal nearer the furnace door, the incandescent fuel lying at the bridge wall would consume all or nearly all

of the carbon before it has time to appear as smoke.

The chief then led the way into the engine room where a compound Ball engine was in operation driving a generator of 500 K. W. capacity. The ammeter showed that the generator was carrying a large overload without the least sign of sparking. The chief explained how the generator was thoroughly cleaned, how the commutator and brushes were kept in good condition and how the generator was subjected to a draught of cool air that was blown through the armature and fields. The draught of air was supplied by means of a fan which ran as long as the generator was operated and the air thus supplied assisted materially in lowering the temperature of the generator while carrying the overload.

A handy arrangement for blowing out the dynamos consisted of a Westinghouse air compressor, which was attached to one of the columns in the engine room, and from which pipes were led to the different machines. Each pipe is fitted with a hose connection and stop cock so that it is only necessary to attach the air-hose and blow out the fields and armature of any of the generators. The chief was particular in explaining that when blowing out the dust from the armature and field coils, the air nozzle should be kept some distance from the insulation as the air may injure or cut the insulation if the nozzle is held close to the coils. In order to prove this, the chief held a polished plate before the air issuing from the nozzle and after a few minutes the plate was scratched. The air from the compressor is also used for blowing out the motors situated in various parts of the building as well as for pneumatic hammers, sand blasts, chasing purposes, etc.

A regular system of measuring the power and finding the cost of producing the same as used in his department was explained by the chief. In order to ascertain the amount of current developed each day, the switchboard is fitted with a recording wattmeter, indicator cards are taken every day, the fuel is weighed and the water metered; in this way the costs for producing power can be closely determined. During his conversation with me the chief said, "Let me tell you that the engineering business is quite different now from what it used to be. A man to be successful, nowadays, must subscribe for the best engineering journals so as to keep posted on modern methods; he should have a good education and practical knowledge about electricity, refrigeration and general machine repairs before he can procure a position worth keeping. We do all sorts of jobbing here ourselves; we line furnaces, set door-jambs and fire arches, repair and make heating coils, rewind armature and field coils of motors, turn down commutators, repair rheostats, put cables on elevators, hang shafting, install wiring for light and power purposes and besides we make our own ice."

As the writer was particularly interested in sparking commutators, the chief explained what should be done to remedy this trouble especially in cases of an open circuit. "You see," said the chief, "if an open circuit exists in the armature winding, you can't cure the sparking without repairing the broken circuit or coil. The way we repair an open circuit here, is to take out the armature and after locating the open circuit, we take out the ends of the broken wire and solder a piece across the break, retape the naked part and drive it back into the slot, put on new binding bands and go ahead. Sometimes the break will be down too deep, in which case a new coil must be put in, but generally the coils lying nearest the surface are the ones usually injured and hence they can be easily repaired. The surface coils are generally injured by allowing the bearings to become worn so as to allow the armature to strike against the horns of the pole pieces, thus breaking the wires in one or more coils. Sometimes sparking and flashing will occur across a large area of the commutator in which case there is good cause to believe that a ground exists between the commutator and mica cone that insulates the bars from the binding nut or shaft. In this case, a series of small holes will appear around the commutator and, if time will not permit the removal of the mica cone, a permanent cure may be effected by digging down in the holes and pouring either thin shellac or varnish in those holes and allowing it to dry. If the shellac is mixed with powdered pumice stone, it will be found a first class substitute for mica. I have cured many a commutator in this way and they are giving excellent satisfaction.

"Sometimes," continued the chief, "a generator will fail to generate, and when this occurs it is a first class plan to test out all the connections. I had a dynamo right in this engine room that was carrying her full load every day when one morning it was started, and, after carrying its portion of the load for some time, suddenly allowed the lights and power to go down. Of course, another dynamo was cut in so as to keep things moving, after which we tested out the leads of the injured dynamo for an open circuit and found none. So we started it up again, but she refused to build up. This time we tested the field rheostat and found over a dozen coils had been burnt out. I rewound the necessary coils, and after connecting it up the dynamo was started and it built up all right. After this experience, whenever a dynamo refuses to build up its voltage, I always test out the rheostat first and usually locate the trouble there. Of course, there are other reasons why a dynamo will refuse to build up, but assuming that the brushes and leads are all right, in nine cases out of ten the trouble will be found in the rheostat."

The chief also described a test which he had recently made on different kinds of pipe coverings. The method he employed for making the test was very simple. He filled a number of stone pitchers with an equal weight of ice water and placed them on the pipes that were covered with the different heat insulators. Each pitcher was supplied with a thermometer and readings were taken regularly from each thermometer. Besides this, one thermometer was used for all the pitchers, the object of which was to offset any arguments or suspicion that might be had with respect to them. Of course, the covering that kept the water coolest was selected.

After thanking the chief for his kindness and promising to call at some future time, the writer departed with a large amount of useful information.

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Motors should be suitable for all classes of work where either a constant or variable speed direct current motor is required. For general driving of machinery or for variable speed work shunt-wound machines are used. For cases where a large starting torque, combined with the constant speed characteristic of the shunt motor, is required, compound wound motors are used. For crane and hoisting service, series wound motors are used.

# EXPERIENCES OF A STEEPLE-JACK

## Engineering in Mid-Air

There is one feature around a power plant that makes the life of an engineer more than one pleasant sweet dream, and that is when the chimney needs repair. The building of a new chimney is a more or less easy matter, but when the old chimney becomes rusty or disintegrated, it takes a cool head to ascend hundreds of feet in the air and perform the necessary work. So few men are fitted for this kind of work, that it is now generally done by specialists, who, besides working on chimneys, also work on steeples and high flag poles, so that they are generally known by the name of steeple-jacks. These men relieve the engineer from the necessity of working suspended in the air or swaying to and fro like a pendulum when in the act of repairing that part of the power plant which most visibly protrudes itself into the atmosphere. One of these men who makes a business of sitting on nothing 200 feet in the air while repairing a chimney top or who scrapes the rust from a chimney while dangling on the end of a rope is John F. Hassler, of Philadelphia, Pa., who, while yet in his twenties, has had many hair-breadth escapes in many parts of the world.

How Steeple-Jacks enjoy themselves

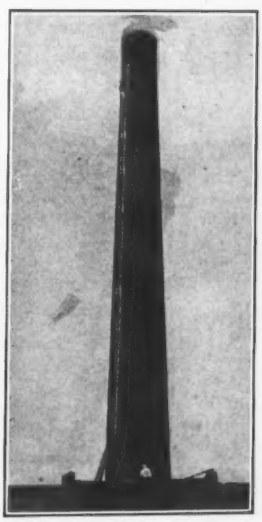
Balancing on one Foot on 50-Foot Pole on 9-Story Bldg. New York

Speaking about his occupation, Mr. Hassler says, "People consider it a dangerous occupation, but if one exercises care it is not dangerous. If a man is frightened he should never attempt to climb a steeple or chimney, but if he feels that he is quite as much at home standing 400 feet in the air with a foothold of six inches as he is on the ground, then he will make a success. It requires a cool head, elastic muscles and steady habits."

In relating his many experiences as a steeple-jack, he said: "I have only had two falls, and they were from such a little height that I would have been ashamed to have been killed. One occurred while as I was ripping shingles from a small steeple, the guide rope broke and I fell about thirty-five feet to a roof. The roof was damaged some, but I was not hurt. The other fall occurred while painting a cooling tower. The plank on which I was standing shifted and fell. I fell with it for about ten or twelve feet, but managed to get my leg around a cross brace in my fall, and thus saved myself. I have, however, had some very anxious moments while suspended in mid-air, one of which occurred on the top of a high building in Philadelphia. On the top of this building there was a flagstaff about forty feet high, tapering to four inches, with an iron rod eight or nine feet long, standing up from the end of the pole. A flag, in being lowered, had caught and bent this rod and my job was to straighten it. I climbed up the staff, which was just large enough to bear my weight, and managed to stand on top of the ball and grasp the iron rod. This rod was quite slender and I had to stand on an exact line with the staff, or, of course, the rod would have bent right over with me. Fortunately, there was no wind, so I stood up on top of the ball, grasped the rod above the bend with one hand and caught it with the other at the level with my chest. Pushing with one hand and pulling with the other, I gradually got the rod straight. The employes of a high building near by crowded to the windows and informed me by signals—it was too far away for shouts—when the rod was straight. It was a job to try any one's nerves, and I was rather glad when it was finished and I had climbed down.

"Another risky job was on the smokestack of Baldwin's Locomotive Works, one of the highest smokestacks in Philadelphia. It was 180 feet high and had a bell-shaped top, fifteen feet in diameter. I had finished painting one stretch of the stack and wanted to switch my pulley around further; this we generally do by twitching the rope from the ground. While working the pulley around gradually it stuck in a joint of the flange and I could move it neither forward or backward. I was afraid to climb up the rope, as the pulley might pull through the crack. So I went up the iron ladder attached to

Climbing Up a Chimney at Wilkesbarre, Pa. to Repair Broken Top



Method of Ascending a Chimney. Repairing Top of 180-Foot Chimney at Atlantic Dock Co., Brooklyn, N. Y.

the stack. When I reached the top I hooked my fingers over the flange, under the bell, and went around, hanging by the crooks of my fingers 180 feet in the air, and moved the pulley.

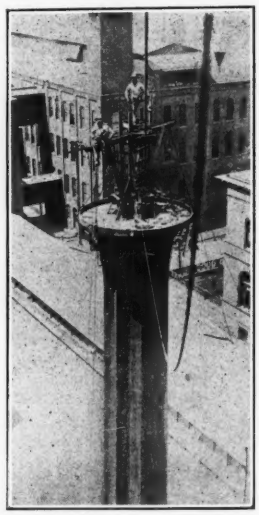
"The riskiest job I ever tackled was on a 175 foot brick chimney, in Brooklyn. Ten feet of the brick work at the top had crumbled and was falling to pieces. I reached the top by splicing one ladder to another on the outside of the chimney. The whole top swayed and shook, and threatened to tumble every second, but we stuck to it until we had torn away ten feet and relaid the bricks.

"A rather difficult piece of work and one that required constant care for the safety of others, was that of repairing the giant chimney of William Sellers Machine Co., Philadelphia. My work was to repair the top of the stack, replacing the plates, weighing two tons, with new ones. After making a preliminary examination of the problem, I decided to scale the chimney from the outside in preference to the laborious and sooty job of recting a scaffold on the inside and going up in that manner. However, I was told that I would not be allowed to use spikes on the stack, so I was forced to go up by way of the interior. The access to the interior of the stack was through a sixty-five foot underground flue, full of soot and gases. The lumber that was used in building the scaffold had to be taken through this flue, and in doing this we were twice nearly overcome with gas. After reaching the top we rigged a tackle from an iron stack, 200 feet high and seventy-five feet away, to the brick stack we were repairing. Over a rope stretched across the seventy-five foot space we slid to and from the iron stack, which was equipped with an iron ladder. We were compelled to use this rather sensational method of ascent and descent, or else risk suffocation in the interior of the stack. However, the hardest part of the work was on top of the chimney where the metal plates had become loosened and were resting on the crumbling brick top. These plates we removed in eight segments, each segment weighing 550 pounds. Our greatest fear was that one of these segments might slip off in handling and go crashing through the roof of the plant and kill the employes working there. In cementing the new iron plates to the brick top we used five tons of concrete, so that it may be easily seen that we did not have any too much room up there for ourselves. We completed the work without an accident, but some anxious moments were spent up there, especially when we were raising and lowering the metal plates.

"A blunder by an unknown person, while I was painting the interior of one of the steel stacks of the Midvale Steel Works, Nicetown, Pa., nearly cost the lives of my assistant and myself. The Midvale Co. decided to have the interior of a 150 foot steel stack lined with firebrick, and I was given the job. While painting the interior, preparatory to lining it, some one opened the smoke vent admitting the smoke from the plant into the stack. We were about half way down when the smoke entered and as it was impossible to reach the top in time to prevent our being overcome by the smoke, we had to drop down seventy-five feet. Of course, it only took us a short time to slide down our tackle, but it seemed hours. After we had reached the ground it was over an hour before we were able to resume our work.

"I have also been up a high chimney during a storm and came within half an ace of being blown off. The storm came up suddenly and in the direction to which my back was turned, and before I could descend it was upon me. I managed to stick on until it was over, but it was a close shave.

"The only time I ever felt dizzy or sick occured while painting a flag-staff on a New York skyscraper. I simply lashed myself to the staff with the flag halliards and waited until the fit passed. A man's only requisite in my business is nerve. I have been up stacks and staffs that I knew were old and rotten and unsafe, not out of bravado, but simply because I was offered the job, and I hate to refuse one because it looks like a lack of nerve. The many inquiries asking if I ever feel any fear reminds me of the incident of the two sailors who were perched on the top of a mast, during a storm at sea. One of them said, 'This kind of weather must be terribly dangerous in the cities.' 'Why?' asked his companion. 'Just imagine the danger of high buildings and chimneys blowing down on the people walking the streets.'



**Method of Repairing Chimney Top at Wm. Sellers & Co, Philadelphia, when Chimney was not in use.**

**A Comparatively Easy Job Painting a Water Tank at the Lodi Dye Works, Lodi, N. J.**

"That's the way with me. I've become so accustomed to my work that I consider it as safe as the safest job on terra firma."

Mr. Hassler tells of an amusing incident that happened to two American steeple-jacks in St. Petersburg, Russia. They were building a gold dome on one of St. Petersburg's cathedrals, at a height of 450 feet from the street. After reaching the top the first thing the steeple-jacks did was to unfurl the American flag. The Russians immediately set up a howl, but the Americans did not pay any attention to them, knowing that they could not reach them. However, that evening when the steeple-jacks made their descent they found the square packed with Russians, wild with anger. The gendarmes told them they would either have to haul down the flag or quit the job. Without a word the steeple-jacks began packing up their tools. Knowing that they would be unable to secure others to complete the job, they tried to reason with the Americans. The steeple-jacks' only reply was, that so long as they risked their necks for the Russian's money, they intended to have their country's flag above them as a guarding angel. "If any man thinks he can pull it down he is welcome

to try," said one of the steeple-jacks, but no one came forward to attempt the feat. The Americans were not bothered after that and until the job was completed the American flag floated above them.

Engineering in mid-air, however, has its fascinations, and on the whole to a man with a clear head and proper judgment it is not any more dangerous than many similar occupations in which death is apt to stare one in the face.

# SETTING OF CORLISS VALVES

By O. F. Dubruiel.

When a single eccentric of a steam engine drives both the steam and exhaust valves, the range of cut-off is limited to about half the piston's stroke, because after the eccentric has reached the extreme length of its throw in either direction, all valve gear motions are reversed. The steam valve must be released before the eccentric is reversed, for if the hook does not strike the knock-off cams during its forward motion it cannot strike them on its return and the maximum exhaust opening, or the middle of the exhaust period, must occur when the eccentric is at the extreme length of its throw. Now to release the expanded steam in the cylinder, before the start of the return stroke the extreme length of the eccentric throw must evidently occur before the middle of the return stroke, and the extreme throw of the eccentric in the opposite direction must occur before the middle of the forward stroke so that the valve must be released before that point is reached.

It will be understood from the above that late release and late exhaust closures are conditions imposed by the single valve gear. These conditions agree very well with moderate speed, but at high speed, earlier release and more compression will be required. This is effected by moving the eccentric forward on the shaft, but the reversing of the steam valve motion would then occur at an earlier stage of the forward stroke and the range of cut-off would be shortened. An earlier exhaust closure may be had by giving the exhaust valve more lap, but this would cause later release of the expanded steam at the end of the stroke, and if the exhaust be shortened it will give earlier release but will not give enough compression.

By referring to Figure 1 it will be seen that when the back bonnets of the valve chambers have been removed, there will be found marks, as shown at A, on the end of the steam valves X-X, which correspond to the working or opening edge of each valve. On each face of the valve chamber will be found other lines as shown at B coinciding with the working edges of the steam port. The exhaust valves Y-Y, and their chambers are marked in the same manner. The lines at E-E on the exhaust valves correspond to the working edge of the valves, and the lines F-F on the face of each valve chamber coincide with the working edge of the exhaust port. On the hub of the wrist plate will be found three lines G, H and I. Where G is the extreme travel in one direction, H being the centre mark, I is the extreme travel in the other; or where G is the extreme length of the forward stroke, I is the extreme length of the return stroke.

The first step in setting the valves will be to set the wrist plate on its central position and fasten it in that position, by placing a piece of heavy paper between it and the large washer that is on the supporting pin. The steam valves should be set so that they will have the proper amount of lap as shown in the following table for cylinders from 9 in. to 60 in.

| *Size of Cylinder.* | *Lap of Steam Valve.* | *Exhaust Opening.* |
|---|---|---|
| 9″ to 18″ | 7/32″ | 1/32″ |
| 20″ to 28″ | 1/4″ | 1/16″ |
| 30″ to 38″ | 5/16″ | 3/32″ |
| 40″ to 60″ | 5/16″ | 1/8″ |

This lap is obtained by shortening or lengthening the rods C-C, Fig. 1. The exhaust valves may be properly placed by lengthening or shortening the rods P-P, and should be so placed that the working edges will open according to the figures in the above table. The paper between the wrist plate and washer may now be removed, so that the wrist plate may be swung free on its pin. Set the rocker arm in a vertical position, using a plumb bob, and connect the eccentric rod to

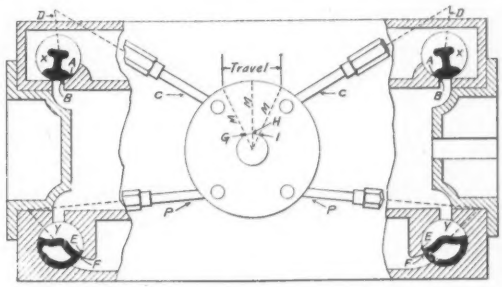



Fig. 1.

it. Then turn the eccentric around on the shaft and note if the distance of extreme points of travel are equidistant from the plumb line; to secure this a little adjustment in the stud-end of the eccentric rod may be necessary. Connect the hook rod to its pin on the wrist plate and again turn the eccentric around on the shaft, thus determining the extreme points of travel of the wrist plate. If all parts have been adjusted correctly the line M will coincide with G and I at the extreme points of travel, and if the lines do not coincide the hook rod must be adjusted at its stud to obtain the equalized motion of the wrist plate.

The valves must also be set correctly with reference to the crank position, and in doing this the length of the rods CC must *not* be changed. Place the crank on one of its dead centres and turn the eccentric loosely on the shaft in the direction in which the engine runs until the steam valve nearest the piston shows the required amount of lead given in the table. After the proper amount of lead has been given the valve, secure the eccentric. Then turn the shaft, with the eccentric, in the same direction in which the engine runs, until the crank is on the opposite dead centre, and notice if the opening, or lead, at this end of the cylinder is the same as on the other steam valve. Should the lead differ from the lead on the other steam valve, it will then be required to shorten or lengthen, as may be necessary, the connection be-

tween the wrist plate and eccentric. When it is necessary to move this connection the second time, the valves will have to be reset with reference to the wrist plate.

To produce an equal cut-off at each end of the cylinder, the cams must be adjusted, and on the column of the governor will be found a stop device, known as the "cam motion," for the purpose of preventing the governor from reaching its lowest point. When it does, the valves must not hook on, for should the governor belt break or become ineffective, the governor would stop and reach this lowest point on the column. This would bring the safety cam in underneath the inner member of the hook, which prevents the latter from catching the steam arm, and as the valves cannot hook on when it is in this position, the admission of steam to the cylinder is cut off and the engine will stop. As this stop determines the lowest position of the governor at which the valves should hook up, it should be blocked in this position while its final adjustment is being made. Now unhook the reach rod from the wrist plate, and by using the starting bar, move the wrist plate over until the lines M and G are opposite each other. The head-end valve should then have opened the port to the limit, which may be ascertained by the marks on the ends of the valve. Adjust the governor rod so that the cam on the disc operated by the governor will come in contact with the inner member of the steam hook, so that the valve will be tripped when the marks M and G, or M and I, Fig. 1, are exactly in line.

To prove the correctness of the cut-off adjustment, raise the governor balls to about the position where they will be when at work, and block them there. Then with the connections made between the eccentric and wrist plate, turn the engine shaft slowly in the direction it is to run, and when the valve is released, measure on the cross-head slide the distance which the cross-head has moved from its extreme position. Still turning the shaft in the same direction when the other valve is released, measure the distance traveled from its extreme position. If the cut-off is equalized, the distances will be equal; but if not, adjust the cam rods until they are equal. While the engine is being turned over, notice the release on the valve and see that it is adjusted so that the release takes place before it reaches its dead centre. In no case will this release measure the same; one end may measure $\frac{3}{8}$" and the other $\frac{5}{8}$", the difference being due to the angles of the rods. With the wrist plate at its full throw and the dash pots to the extreme bottom, adjust the dash pot rods so that the brass link which connects the valve rod to the wrist plate will just fold together easily, not binding in any direction. If, when the engine is put in motion, the links fail to fold together at each stroke, lengthen the dash pot rod a little at a time. When, however, these links fold together too closely, the valve stem will appear to be strained, which will be indicated by lifting motions at the joint between the valve arm and bonnet; shorten the dash pot rods until this is free.

*Adjustment for Two Eccentrics—Double Ported Valves.*—With two eccentrics the admission and exhaust valves can be adjusted independently and steam may be cut off at any point of the stroke, after knowing in which direction the engine is to run. The determining of the direction in which to turn the eccentric is very simple. In setting the steam valves there is but one eccentric to turn, but in setting the exhaust valves there is a second eccentric to turn. However, this second eccentric in no way adds any complications to the work; all that is required is a little more time. The work of centralizing the positions of the various parts, equalizing the movements and setting the adjustment of the valve gear, is the same as in the single eccentric engine. Set the wrist plate as shown in Fig. 2 and adjust the valve rods, but in this case the steam valves are set with negative lap, which is usually a little less than half the port opening. First set the exhaust eccentric, as it is placed next to the bearing, and turn the engine until the piston is in the desired position, so as to obtain a compression of about 5 per cent. of the stroke. Then turn the exhaust eccentrics loosely on the shaft in the direction in which the engine is to run, until the exhaust valves have the lap given in the table; then secure the eccentric. The steam eccentric is set by placing the crank on one of its dead centres and turning the eccentric loosely on the shaft until the steam valve on the same end as the piston has the required opening or lead given

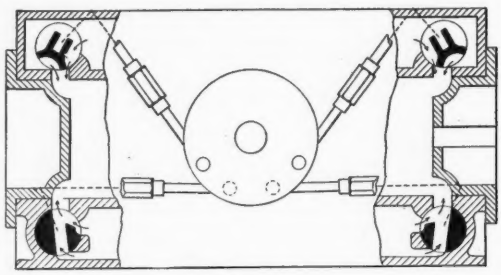


Fig. 2.

in the table. The arrangement of the rod connection is the same in every respect as that of the single eccentric valve gear. With the single eccentric, a slow initial valve motion is imperative and is obtained by the lateral movements of the radius rods, but with two eccentrics quicker initial valve movement is desirable and is obtained by reversing the valve motion, as shown in Fig. 2. Separate eccentrics require separate wrist plates, which are usually placed on the same pin.

After the valves have been set by the above method, the indicator should be applied to verify the adjustment, if the best results and most economical operations are to be attained.

### Assembling Generators or Motors.

If, for any reason, a generator or motor must be taken apart, the following precautions should be taken when the different parts are re-assembled.

Clean carefully all magnetic joints and coat them with a thin layer of oil before fitting them together. Draw the bolts up tight, and be sure that the surfaces fit closely.

See that the bearings and shaft are perfectly clean before assembling and that no grit or dirt gets into them when the armature is being put into place.

Be careful that the spools or armature do not strike on sharp corners, which would damage the insulation.

Observe carefully the markings of all parts and in assembling see that they correspond.

Clean all connection joints carefully before clamping them together and tighten well all nuts and screws.

# PRACTICAL TESTS WITH PRODUCER GAS PLANTS

By A. S. Atkinson.

The use of producer gas plants for generating electric power for the operation of railroads is a matter which vitally concerns a great number of city and suburban railway companies, and their adoption experimentally on a small scale usually results in a larger installation for permanent use. In a great many instances the gas engines are first employed for auxiliary purposes, and in this work ample tests can be made without weakening the general output of the original steam plant. There are several hundred railways throughout the country which are making such experimental tests, and a considerable number of others which have changed their motive power so as to depend almost entirely upon the gas engine for the prime mover. With an increasing amount of statistics of a reliable nature on this subject, it will be much easier in the near future for enigneers to figure out accurately the exact results which can be depended upon under almost all conditions of work and load.

Some excellent results have thus been obtained in the plant of the Boston Elevated Railway Company, which should prove of great value for purposes of practical comparison. Two small plants were installed by this company with gas engines for the purpose of ascertaining their relative value as independent units. The distribution of the current to some of the outlying districts from the power houses made it advisable either to construct new sub-stations for transforming the current or to build new power-generating units of great cost. The engineers finally decided to make the improvements by installing two small gas-producer-engine stations at Medford and Sommerville. To make the test thorough two different makes of engines were installed at the different stations. At the former was installed a Wood gas producer and auxiliaries, double-acting two-cycle Koerting engines and Crocker-Wheeler generators, and at the latter a Loomis-Pettibone gas plant, American-Crossley engines and Crocker-Wheeler generators. The plants were thus sufficiently different in equipment to secure reliable data for comparison.

The main purpose of the installation was to make comparisons of cost of operation and efficiency with the older steam plants in use at the other stations. To do this, reliable data was collected daily, and every effort was made by the engineers to secure the best results possible. Good gas engineers were employed at the stations so that no injustice would be done to the prime-movers through ignorance.

Neither station has been run quite a year yet, but for the first six months the operation proved to the satisfaction of the engineers that the plants were not only unusually reliable, but far more economical than the steam plants. So far there have been no important shut-downs in the gas house, and this part of the plant has proved all that was expected of it. The gas engines at first gave some slight trouble, and the engineers made a few changes, but for the past few months the engines have proved as satisfactory as the gas house. One of the prime causes of the shut-downs in the gas engines were too rapid starting, which caused hot crank-pins and improper water connection with the piston.

The engineer in charge informed the writer that the engines can be set running so quickly that the temptation is to start without proper consideration of the danger that may follow. The overheating of a crank-pin is quite common in plants of this character, but the remedy is to use a little common sense in operating the engine. After a long shut-down, in starting the engine too suddenly the oil often does not have time to reach the crank-pin to prevent overheating. The engines at both of the stations have been started inside of 35 seconds, but 60 seconds is the average time required, and it is the opinion of the engineers that no attempt should be made to do it in less time.

The question of operating the gas-producing part of the plant economically, efficiently and quickly was one that particularly interested the engineers. In the first place, many trials were made to ascertain the relative length of time required to get the producer plant ready for operations. At the Sommerville plant the producers have been out of commission a number of times, and it was found that within fifteen to twenty minutes the plant could be got into full operation. In the steam plants it took, at the lowest time, one hour to get the fires going and steam up, and more often it was an hour and a half. This gain in time of getting the plant into full operating condition after a shut-down is of vital importance in many ways. It has proved so at the Sommerville station, especially as it is shut down occasionally for special reasons. At this time the ashes are removed, and the scrubbers cleaned. It has been considered more economical at this station to clean the ashes out of the producer plant about twice a week, and to clean the scrubbers every two or three weeks. The plant could be run longer without such cleaning, but the tests made showed that to get the most economical results the above were the most satisfactory intervals.

The fact that the producer part of a gas plant has to be shut down for cleaning out the ashes has been frequently quoted as against its universal employment where continuous power was demanded. The time required for cleaning out the ashes has averaged three hours at both the plants of the Boston Elevated Railroad, and twenty minutes for getting the gas ready for full operation. Such an amount of time twice a week, taken at a time when the load factor was at its lowest, practically does not interfere with the steady work of the road. The cleaning of the wet and dry scrubbers is likewise no material disadvantage, and the work is not any more difficult or prolonged than that required for cleaning boilers, soot chambers and furnaces.

The problem of handling the gas plant was entrusted to a good gas man, who, in steam engineering, would command about the same wages as a good fireman, and his duties were simpler, and the results more satisfactory. The chief thing was to make a uniform grade of gas at all times. The best engine supplied with gas that shows great variation in quality from day to day cannot be expected to do its best. The highest possible efficiency of the station, it was considered, depended upon three things: the fuel, the care of the engineer in

charge, and the plant equipment. The quality of the gas and its uniformity of composition and volume depended upon these three factors.

The average Pocahontas coal was used for the plant. The same grade and quality of coal by test was supplied for the plants during their whole operation. The average result showed that to deliver a kilowatt-hour from 1.5 to 1.75 lb. of coal was used, and this included all the fuel burnt. A good deal depended upon the load factor, but the amount consumed did not surpass the maximum. In comparison with the steam plants, from three to four pounds of coal were used to secure the same amount of current. The original cost of installation of the gas plant was much larger than for a steam plant of similar output, but the saving in the fuel would soon make this difference disappear.

The operation of the producer part of the plant saved in the coal, both through the amount of fuel consumed and in the simplicity and quickness of starting up. It was found that the loss in banking the fires was far less than the steam plants, and no danger of accidents was apparent. A good gas man operated the plant for six months without any mishap, and it was estimated that such a man could run as many horse power of gas producers as he could of steam boilers. The skill of the engineer, however, is a point that needs some emphasis. At first the railroad company experienced some difficulty in keeping up a uniform grade of gas, and as a result the engines showed a variation in their action. To suppose that an inexperienced man can run a gas producer is much like assuming that anybody without previous experience can fire a boiler or run a steam plant. It has been found that the fuel consumption of any plant depends more upon the firemen's skill than upon any other factor. A good fireman will save 10 to 20 per cent. of fuel, and produce a higher efficiency than one who does not understand his business. So it is in operating a gas producer. A gas producer must be run just as scientifically as a steam engine. There is a reason for everything, and a right and wrong way to do it. The quality and grade of the coal may often be at fault, but very often it is the lack of experience on the part of the gas man in charge. For that reason it pays to secure the best operator where the plant equipment is of the best. The depreciation in the producer should not be large, but in the hands of a poor operator it will increase at the rate of 20 per cent.

With the gas producer in good operation, the question of attending to the engine is simple, although here, too, knowledge and experience of a high order pays. In the Boston railroad plants the gas engines were carefully designed and completely equipped with the best of everything. There was a duplicate system of igniters, and as a result there has been no trouble experienced in the ignition. As this is one of the most common troubles in operating gas plants, it is quite evident that the avoidance of it is possible where the equipment is complete.

There was little loss of efficiency through leaks from the first. When the engines were first started up there was some trouble. This was due not to improper ignition, but to faulty valve setting which caused a reduction in the output of the engine. But a little repairing and tightening of parts quickly stopped this. Poorly set and leaky valves of a steam engine are not always so easily discovered as those of a gas engine. Either a noticeable reduction in the output or the knocking sound gives warning of the trouble, and the remedy is easily applied.

Probably the greatest trouble found at the Boston plants was from noisy exhaust and some back-firing in the engines. At the Medford station the noisy exhaust and explosions caused serious complaints from the residents. This district is strictly in a residential part of the city, and anything which approached a nuisance was quickly complained of. Instead of trying to oppose public opinion the company proceeded to start an inquiry, and its engineers sought to repair the difficulty. After a month's experience the engineers secured definite results, and the noises have been reduced to the vanishing point. The exhausts are practically noiseless, and no objection has been made lately to the operation of either the gas engines or the producers.

The question of back-firing for a time was considered quite objectionable, for it did materially reduce the power of the engines. This, however, was due chiefly to premature ignition, a matter which was speedily remedied. The trouble has long since been practically eliminated, and there is no chance of its returning.

From these experiments it is quite manifest that even in the best designed gas plant there should be a period of testing and turning up of different parts by competent engineers before any final results are declared. A good many operators with engines experiencing trouble from premature ignition and back-firing are apt to get discouraged and condemn the equipment. Now some of the most economically-operated engines of to-day gave similar troubles when first installed. It is no more than what may be expected from any new steam plant. There are faulty valves to be re-set, imperfect foundations of boilers to be trued up, and various pipes and valves to repair. Sometimes this trouble is due entirely to the work of the construction engineer and not to the manufacturer or designing engineer. In the work of installing the plant it is quite easy to make a blunder or miscalculation, and as the result of this a long train of disasters of a minor nature may supervene. There is need of expert engineers in installing a plant who understand exactly the demands and specifications of the designing engineer.

On the whole, the two small plants at Boston have proved more than satisfactory, and their work has paved the way for larger installations later. They have saved money on the investment, and performed an experimental duty which favorably recommends them to other railroads. The simplicity of the plant and its easy and efficient operation are matters which cannot well be important factors in the whole question of railroad operation.

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It is absolutely necessary that an ample supply of oil for lubricating purposes be used in the stuffing box of an ammonia compressor, otherwise it will be found that the heated ammonia gas at high pressure will very rapidly deteriorate the packing. Pure mineral oil of good body will be found to be the best lubricant; animal and vegetable oils should not be used, as they will saponify on contact with the ammonia, causing much trouble and probable shut-downs.

# INDIA'S ELECTRICAL POWER DEVLOPMENT

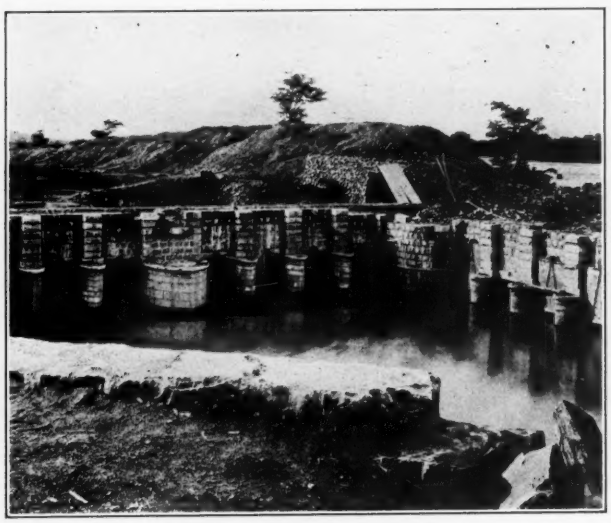
## Largest Hydro-Electric Installation in Southern Asia

By Frank C. Perkins.

The development of India during the past few years has been most rapid and extraordinary, and without doubt nothing has had greater effect than the use of electricity as a motive power for industrial purposes in that far eastern country, this being possible by Nature's gift of immense water powers.

Hydraulic Power Channels

It may be of interest to consider some of the unique features of the Cauvery power scheme, which is the largest hydro-electric installation in southern Asia. It is located in southern India, in the province of Mysore, and has been in successful

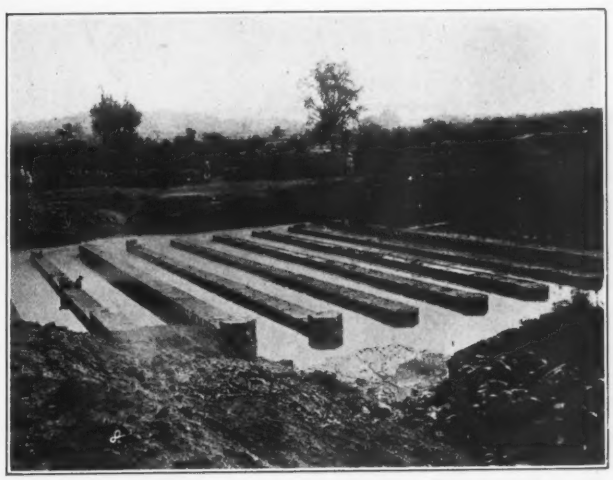


Head and Scouring Sluice

operation for some time, the second installation having been completed in 1904, since which time many changes has been made and additional electrical and hydraulic equipment utilized to increase the capacity of the plant.

The power is transmitted over several long-distance overhead power circuits, a distance of nearly 100 miles to the Kolar gold fields, where the mining operations are now almost exclusively carried on with electrically-driven machinery. The power is transmitted by three-phase alternating current, at a pressure of 35,000 volts, not only for supplying cheap power for mining service, but also for supplying current for lighting and power service in the city of Bangalore, which has a population of nearly a quarter of a million people.

The Hindu village of Sivasamudram is located near the Cauvery River Falls, and there is a head of nearly 400 feet available with water power varying up to a maximum of 150,000 horse power or more, the latter being available during the rainy season. The main river divides into two branches about 1,500 feet above the channel intake, one branch flowing north and the other east, and two low-level dams were constructed to divert all of the water from the river into the channel intake



Eight-Vent Aqueduct, Supply Channel

during the dry season. The water of the eastern branch is diverted by the upper dam more than 1,000 feet above the intake, while the northern branch of the river is diverted by a very long dam of V-shape construction. During the rainy season the water rushes over the top of this dam, which is about a third of a mile long, to the depth of several feet,

The Cauvery power house, noted in the accompanying illustration, which shows the interior with its electrical generators and hydraulic turbines, is located about one mile below the Cauvery falls, while the head gates at the channel entrances are installed nearly the same distance above the falls. There are two channels about three miles long following natural grades or contour of that section, the sides of the two channels being from ten to thirty feet apart respectively at top of base. These channels have trapezoidal sections, the bed width being about 12 feet in rock and 18 feet in earth cutting.

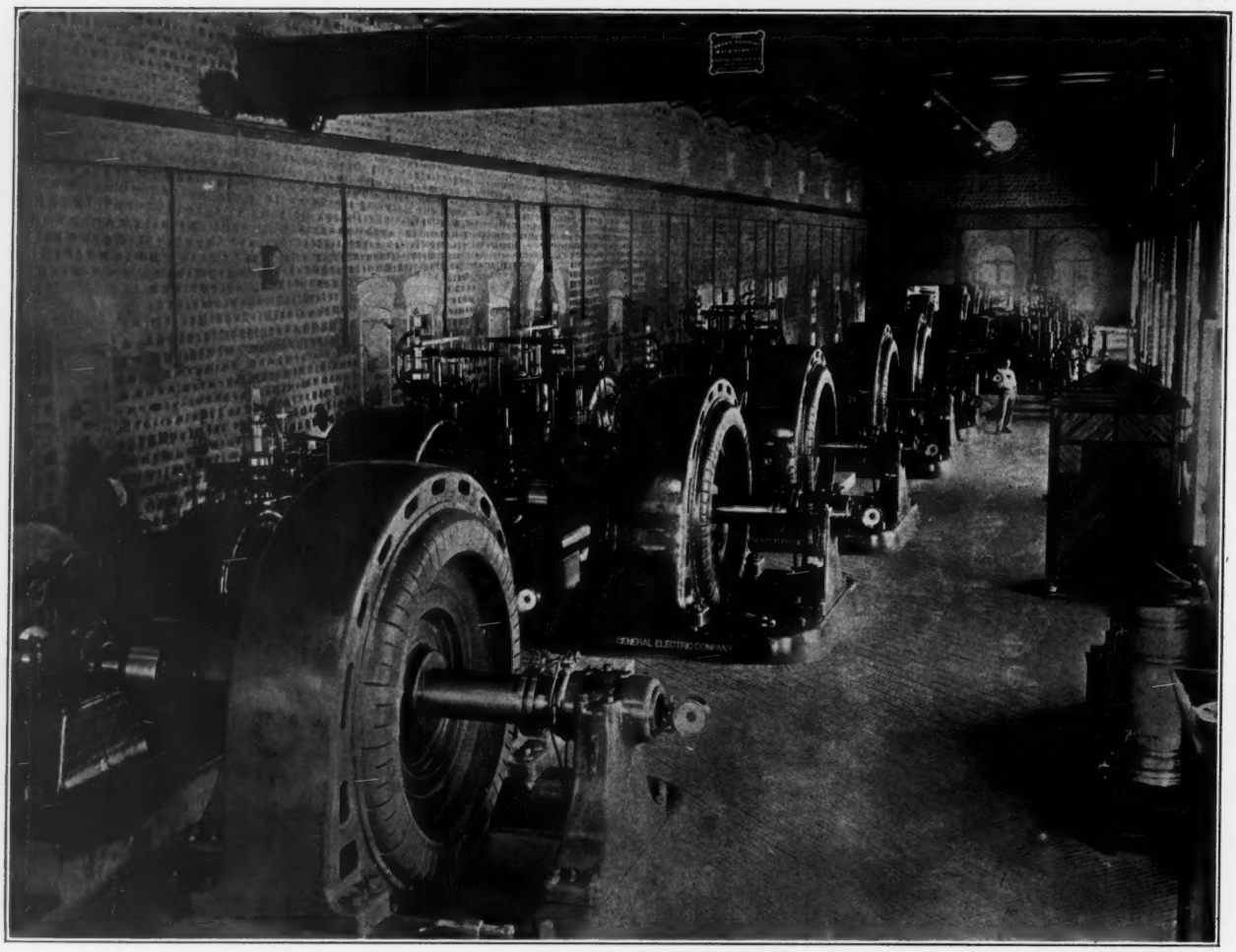
The accompanying illustrations show the construction of the head and scouring sluice, and the eight-vent aqueduct of the supply channels. The water is supplied from the intake at the head works through four vents to each channel. These vents each measure about 5 feet by 5 feet in section, the flow in the channels varying from 2 to 3 feet per second, according to the gate opening. The scouring sluice vents are about the same section as the other, 5 feet by 4½ feet, arranged on the river side of the intake channel.

There are two parts to the forebay, one of which supplies water to the new penstocks and the other to the old ones, the two channels supplying water through the double forebay to eight penstocks in all, the water in the forebay being not over six feet in depth, with the surplus pasisng over the waste weir. The generating station below the bank is supplied with water through penstocks nearly 1,000 feet in length, these being of steel construction, each of the five for the last installation supplying water to an impulse water wheel of 1,250 horse-power capacity.

As noted in the illustration of the power station, each of these horizontal impulse turbines is directly connected to a 750-kilowatt three-phase alternator built by the General Electric Company, and there are three exciter units of 75 kilowatts capacity of the same make, each operating at a speed of 465 revolutions per minute. These exciters are over-compounded, supplying a current of 110 volts at no load and 115 volts at full load. Each one of these exciters is capable of exciting the fields of the generators for a load of 5,500 kilowatts at the station with a power-factor of 95 per cent., but two exciters are utilized, the third being held as a reserve and for station lighting, the full load of the power house being about 7,000 kilowatts.

The main alternators supply a three-phase current of 2,200 volts pressure, with a frequency of 25 cycles per second. The horizontal turbines are directly coupled to the alternators, driving the same at a speed of 300 revolutions per minute, these generators being of the revolving field type, with Y-electrical connections. The efficiency of the turbines is 70 per cent. at half load, and 75 per cent. at full load of 1,250 horse power, this being developed with a head of 382 feet and a flow of 37 cubic feet per minute. The power station is about 260 feet long, and between 50 and 60 feet in width, and is built of black trap and granite.

The step-up transformer station, the interior as well as an exterior view of which is given, is located about 1,000 feet from the power station, and about 400 feet above it on the bluff, and



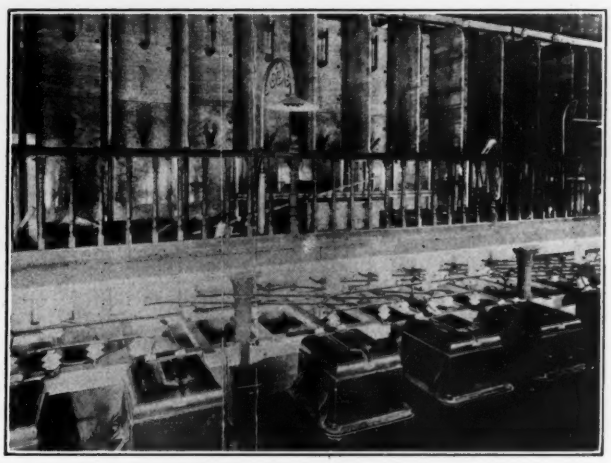

**Interior Generating Station, Canvery Power Scheme, India**

from this building the transmission lines carry the current at 35,000 volts to the various sub-stations. The current is raised in pressure from that of the generators 2,200 volts, to 35,000 volts by means of seven banks of air-cooled step-up transformers built by the General Electric Company, each having a capacity of 350 kilowatts. The power station and transformer house

**Step-Up Transformer Station**

are both divided into two sections, which may be operated separately or together, as desired. Motor-operated oil switches of the quick-acting 2,200-volt type are used between the two sets of low-tension bus-bars.

Automatic motor-operated double-break oil switches of 35,000 volts are used on the high-tension lines, one for each transmission circuit, an automatic bellows time limit relay being employed to trip the switches at about 100 per cent. overload. There are two voltage regulators employed, connected in multiple, one being adjusted for high voltage and the other for lower voltage range, controlling the pressure from 115 volts full load to 95 volts no load. The regulation takes place auto-



**Interior Transformer House**

matically, with the change of load keeping the voltage constant at the distribution end of the line. The voltage regulator may be operated with one exciter or two or more exciters in parallel, and it is claimed that they are of great value in keeping the transmission line pressure from exceeding a safe voltage in case the station load should all be thrown off, by accident or other cause, acting advantageously with the impulse turbine governors.

It is stated that the voltage is held practically constant at about 30,000 volts at the receiving end of the long-distance transmission line at the Kolar gold mines, even though the variation at the power house is from 30,000 volts to 37,000 volts, according to the load from a maximum to no load. The line loss is about 15 per cent. at ordinary loads, the potential loss being about 6,000 volts at full load and less than 1,000 volts at no load, the power-factor in the former case being 95 per cent.

The monsoon weather is very trying in India in keeping the insulation perfect. It is stated, however, that more difficulty is found with the low-tension Kolar distribution lines than with the high-tension circuits, the trouble resulting from the driving rain entering the distribution towers during rainstorms, and severe winds being very troublesome.

It is maintained that this hydro-electric power transmission in southern India has given excellent satisfaction, supplying cheap power to the mines, as well as providing all of the comforts which electricity can give, in the way of lighting, heating and power service to the inhabitants of Bungalore.

In the development of this water power it was necessary to utilize animal power very largely for hauling the heavy machinery to be installed, water buffaloes and elephants being employed for this purpose.

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### Massachusetts License Questions for June.

The following questions were given at an examination for first-class license held in Boston, Mass., the first week in June:

Considering a horizontal cross-compound condensing engine, 2,000 nominal horse power,

1. Give approximate dimensions of each cylinder.
2. Give economical revolutions per minute.
3. What should be the size of pulleys on engine and shaft to produce a shaft speed of 400 revolutions per minute?
4. Give initial pressure of each cylinder.
5. Give terminal pressure of each cylinder.
6. Give mean effective pressure of each cylinder.
7. Give point of cut-off for economy.
8. Draw approximately the theoretical cards for each cylinder for economy.
9. Draw some cards with admission late one-sixteenth of the stroke.
10. Calculate horse power of each cylinder from the cards you make.
11. Describe a Babcock & Wilcox water tube boiler.
12. How are the tubes secured at the ends?
13. What means are provided for cleaning them?
14. What kind of joints are there in a B. & W. boiler?
15. How are the tube sections connected to the tube sections?
16. Describe the form of steam section in a B. & W. boiler.
17. How are the steam sections stayed or braced?
18. How does the water circulate in a B & W. boiler?
19. How and to what are the water columns attached at the bottom and top ends?
20. Describe a baffle plate in a B. & W. boiler. Where is it located and why is it used?

# PARALLEL RUNNING OF ALTERNATORS

## Division of Load, Limits of Angular Variation, Synchronizing, Starting Up and Shutting Down

When running two direct current dynamos in parallel, the only precaution that is necessary, after bringing the machines up to speed, is to see that the voltage of the two are about the same, so that each take their share of the load, and should the speed of either machine change, the voltage can be regulated by the field rheostat. But when running two alternators in parallel, the principal precaution that must be taken is to see that the speeds of the two alternators are exactly adjusted. With direct-current dynamos it is just as easy to run two 100-volt machines in parallel as two 600-volt machines, whereas, the design and frequency of the alternators running in parallel are quite a factor in attaining and maintaining satisfactory synchronous running. Machines of low armature reaction have large synchronizing power, but are liable to heavy cross currents if they are thrown out of step through some accident or by being improperly connected into parallel. Machines of high armature reaction have less synchronizing power, but are less liable to injury should they fall out of synchronism. The maximum angular displacement that may take place between two machines in parallel without causing objectionable phase difference, decreases with increased number of poles. For this reason high frequencies are, generally speaking, less favorable to parallel operation than lower frequencies. Machines of the highest frequencies ordinarily can, however, be successfully run in parallel if the mechanical arrangements are suitable.

In connection with the operation of alternators and the necessary precautions which must be taken, in order that they shall give the best satisfaction, when running in parallel, the General Electric Co. gives the following information: Machines to operate in parallel must be run at such speed as will give exact equality of frequency. If the prime mover running one machine tends to produce a lower frequency than that running the other, the machines cannot carry equal loads.

When two alternators operate in parallel, each must carry an equal amount of load proportionate to the power received from its prime mover. While the machines are in step they revolve at equal or equivalent speeds. If one engine or water wheel at this speed governs in such a manner as to give more power than the other, this machine must carry more load, no matter what the field excitation may be. If under such conditions the field excitations are correct, both machines will deliver current to the line in approximately the proportions in which they receive power from their prime movers. If the field adjustments are incorrect, there will be idle currents between the machines in addition to the currents which go to the line.

When compound alternators are operated in parallel, equalizer connections should be used so that the rectified alternating current can properly distribute itself into the fields of all machines. Without equalizers, an unstable condition may exist which will render parallel operation unsatisfactory. This applies particularly in the case of machines driven from the same source of power. The greater the amount of compounding, the greater will be the tendency to instability.

With machines having a commutator inserted in one lead instead of at the middle of the armature winding, care must be taken that the commutators are in corresponding leads when the machines are thrown into parallel, otherwise there will be a short circuit when the equalizer switch is closed.

When dissimilar compound machines are operated in parallel, arrangements must be made by which the voltage between the commutator segments under different conditions of load with equal degrees of compounding is brought to approximate equality; that is, resistance must be put into series with the fields of such of the machines as require less voltage for compound excitation. As in direct-current machines, to get the best condition of parallel operation, the resistance of equalizers and of the series windings must be proportioned so that the rectified currents will distribute themselves properly.

If two machines are belted to separate prime movements, their parallel operation is dependent upon the governing of the

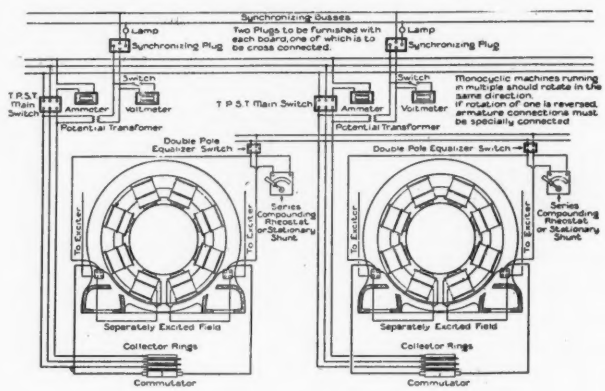



Fig. 1

prime movers. If they are belted to the same source of power, their parallel operation depends upon the proportions of pulleys and belts, and upon the tension and friction of the latter. Under such conditions the pulleys and belts must be adjusted with great nicety, so that both machines will tend, with proper belt tension, to run at exactly the same frequency. Even where pulleys are of exactly the correct dimensions, a slight difference in the thickness of belts may cause considerable cross-current or unequal division of load. With arrangements carefully made, good results can be obtained.

With direct-connected machines, engines must not only be adjusted to run at synchronous speed, but must also be provided with fly-wheels large enough to prevent appreciable variations of frequency with each revolution. Inequalities of speed, due to insufficient fly-wheel effect, will cause periodic cross-currents between dynamos, or will entirely prevent their operation in parallel. The greater the number of poles in a direct-coupled machine, the less the angular speed variation necessary to cause trouble.

As stated above, high speeds are much more desirable with direct-coupled alternators than low speeds, and low frequencies present less difficulties than high. The desirability of high

speeds with direct-coupled alternators cannot be too strongly stated. While an increase of fly-wheel effect will equalize the angular irregularities of an engine's motion, it cannot bring about such good results as would be brought about by a similar reduction of angular error effected through an increase of speed. While a large fly-wheel steadies the motion, it may tend to prevent correction of the angular error through the effect of the cross-currents. Cross-currents which flow in machines having light fly-wheels may have an effective tendency to hold them together; while machines with very heavy fly-wheels may tend to act independently of each other as far as angular variations are concerned.

These matters should be carefully considered in installing direct-connected alternators. Where the engines operate at the same speed and have the same number of cranks, this trouble can sometimes be overcome by synchronizing the engines themselves so that the impulses in both come together. When the fly-wheel effect is insufficient, the frequency will fluctuate and this fluctuation may cause serious trouble if synchronous motors or rotary converters are connected to the circuit. When the cranks of two engines coupled with alternators are synchronized, any fluctuation of frequency which is due to lack of fly-wheel effect will still exist, although it may not effect parallel running.

Where alternators have to be run in parallel by engines to which they are directly coupled, it is generally desirable to use engines having as many cranks as possible, so that the crank efforts will be well distributed throughout the revolution, and will not tend to produce an irregularity of motion.

The amount of angular variation which is allowable in alternating generators depends upon circumstances, and is more influenced by the difficulties of operating synchronous apparratus that it is by the question of parallel operation. Two and one-half degrees of phase variations has been fixed upon as the limit allowable in ordinary cases. It will, in certain cases, be possible to operate satisfactorily in parallel, or to run synchronous apparatus from machines whose angular variation exceeds this amount, and in other cases it will be necessary and desirable to obtain a better speed control. This two and one-half degree limit is intended to imply that the maximum departure from the mean position during any revolution shall not exceed 2½-360ths of an angle corresponding to two poles of a machine. This angle of circumference which corresponds to this two and one-half degrees of phase variation can be ascertained by dividing two and one-half by one-half the number of poles; thus in a twenty pole machine, the allowable angular variation from the mean would be 2½-10ths of one degree.

Most single phase and polyphase alternators can be run together in parallel with either direction of rotation without change of connections. With compound monocyclic machines the case is different. With these machines, teazer coils must be connected properly in parallel, as well as the main coils, and the series windings must be energized from the main leads which carry the heaviest currents.

Fig. 1 shows the ordinary method of connecting machines for parallel operation. This diagram applies as well to single-phase machines as to the three-phase and monocyclic types, the middle wire shown in the diagram taking no part in the arrangements for synchronizing. In monocyclic and single-phase generators, the alternating-current ammeter should be placed in the lead from the collector ring next to the armature. The drop of electro-motive force in the lead between the alternating-current bus-bar and the collector ring, adjacent to the commutator, should be the same for all single-phase and monocyclic generators running in parallel. For all alternating-current generators, when compounded rheostats are mounted behind the switchboards, the leads should run to the equalizer switch terminals instead of to the connection boards on the generators.

The usual method of synchronizing alternators is to connect a lamp or lamps to the circuit of two transformers whose secondaries are connected in series, and whose primaries are connected to the different circuits to be synchronized. As long as the frequencies of the two circuits are unequal, the lamps will be alternately light and dark. When the fluctuations of the lamps become very slow, the machines are nearly in synchronism. With connections made as shown in Fig. 1, the machines will be in phase when the lamps are bright, and in opposition when they are dark. The switch should be closed when the pulsations are very slow (about one in two or three seconds), and while the lamps are at maximum brilliancy.

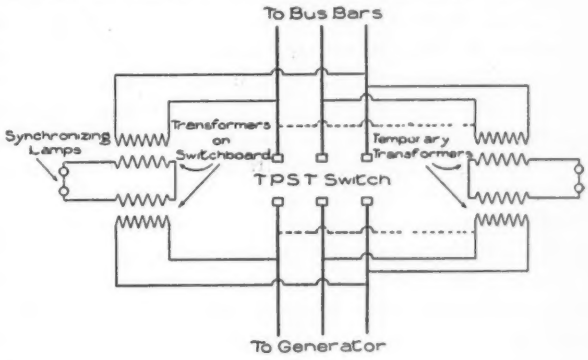



Fig. 2

When two separate transformers are used for synchronizing alternators, as shown in Fig. 1, care should be taken to observe whether their connections are the same, otherwise their indications may be misunderstood. For this reason it is better to use regular synchronizers, consisting of two transformers properly aranged and mounted together. The connections of a pair of transformers can be proved by testing with primaries and secondaries in series.

With polyphase or monocyclic machines, the synchronizing of one side of the circuit does not prove that the other phases are ready for parallel connection, unless we know that the connections correspond all through the machines. When machines are first thrown into parallel, we can make sure that the connections are correct by using two sets of phase lamps, which wil give simultaneous indications that both phases are in step.

In Fig. 2, temporary transformers are shown connected by dotted lines to the outside blades of the switch, so that they are in parallel with the synchronizing transformers. This connection should be made first to be sure that the phase lamps on the board and the phase lamps connected to the temporary transformers operate together. If when this connection is made the lamps are not simultaneously light and dark, cross the secondary leads from the temporary transformers. The lamps should then operate together.

When a machine driven by a separate engine is thrown in parallel with others which are carrying load, the throttle should be partly closed, so that it can just run at synchronous speed without carrying load. After it is in step with the other machines, load can gradually be taken on by giving it more steam. If this is carefully done the voltage on the circuit is not disturbed by the addition of the new machine.

When a belted machine is to be thrown into parallel with others driven by the same shaft, its belt tension should first be reduced, which will tend to bring enough slip to bring it into step with the loaded machines. After it is thrown in, it will gradually take load as the belt is tightened.

In shutting down machines operating singly, both the generator and exciter field resistances should be cut in by turning the rheostat before the line switch is opened.

When two or more generators are running in parallel on the bus-bars, one may be shut down at any time. The equalizer switch should be opened first, then the load reduced by throttling the engine or by slackening the belt. As soon as the load is practically off, open the main switch.

With high voltage machines it is absolutely essential that they be kept scrupulously clean. Small particles of copper or carbon dust, or the ordinary accumulation of dust about the station may be sufficient to start a disastrous arc. It is recommended on the smaller machines that they be gone over carefully with hand bellows from time to time, blowing out around the coils of the armature and shunts. The commutator collector should receive careful attention and be wiped thoroughly every day.

From time to time the machine should be thoroughly overhauled and given a coating of air-drying japan after cleaning. Machines of the rotary field type are so constructed that it is a comparatively easy matter to get at every part of the armature coils. In a large station it is recommended that an air compressor be installed so that a hose can be held to the machine and the dust thoroughly blown out.

It is advisable to have rubber mats in front of high tension switchboards and at the floor of the commutator-collector end of the generator. If it is necessary to adjust the brushes while the machine is in operation, the attendant should stand on the mat, and it is also recommended that he wear rubber gloves.

Both commutator and collector rings require a very slight amount of vaseline. In applying it, a dry stick with a little chamois leather tied to one end may be used, so that there will be no danger of coming in contact with the brushes.

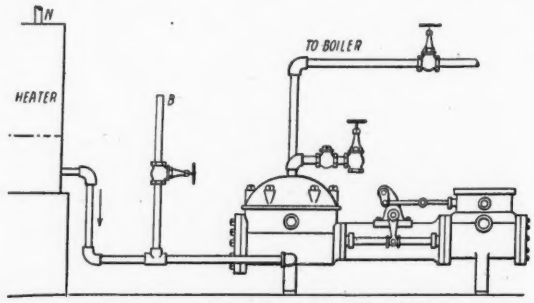
With the brushes properly set and all screws firmly tightened into place, the generators should require very little attention while running. It is well to note from time to time whether the oil rings are working properly.

## Pumping Hot Water.

The pumping of boiling water and feeding it into a boiler has given persons, unfamiliar with this work, no little trouble, says a writer in *Southern Machinery*. In the first place, we do not raise water with the pump, the latter only displaces the air in the pump cylinder and suction pipe. The atmospheric pressure forces the water up into the pump. A pump for handling hot water should be differently constructed from a cold water pump.

Some of the ordinary pumps wil give trouble when used for hot water pumping. The plunger should be larger on the water end and have little clearance in this end, so as to avoid the cushioning effect of the vapor when the water is close to the boiling or steaming point. The accompanying arrangement will work under the most severe conditions. We should first see that combination packing is used which contains no rubber. I have used plaited hemp with good success.

In the drawing, the exhaust enters the top, and water at *N*. Sometimes in open heaters the water is vaporized to a certain extent and the heater must be placed above the pump, as shown. This keeps the pump barrel submerged. A vapor valve is provided, and the point *B* must be a little higher than




**Arrangement for Pumping Hot Water**

the water level in the heater. This valve can be opened while pumping to allow the vapor to pass off. I have used a plain pipe in this place, but closed at the top. That helps some, but the arrangement shown I believe is best.

A check valve is placed on top of the pump so that when the angle valve is open the check will allow the vapor to pass off. This also makes a good arrangement, but I have worked the system without this by graduating the valve, throwing more pressure on the pump, so as to keep the pump from hammering, as the vapor and hot water become elastic and will cause the pump to jump and knock as though it were going to pieces. It is better to ask the maker to furnish a pump for hot water so that it will be properly proportioned. It will be found more difficult to pump hot water with a quick-acting pump than one of the duplex type. The pump with a steam-actuated valve is hard to work on hot water unless connected as shown. By closing the valve it can be worked nicely and noiselessly.

When starting an ammonia compression system, it is impossible to eject all the air from the system by means of the compressor, therefore it is advisable to insert the requisite charge of ammonia gradually, the best practice being to put in 60 to 70 per cent. of the full charge at first and cautiously permit the air remaining to escape through the purging cocks with as little loss of gas as possible, subsequently inserting an additional quantity of ammonia until all the air has been replaced and the complete charge has been introduced.

Thomas Hollowell, engineer at the Downingtown, Pa., plant of the West Chester Street Railway, met with instant death on July 10th by coming in contact with both sides of the street railway circuit while he was adjusting the brushes of the 550-volt generator.

# THE SAFETY VALVE

## The Leves Valve, Pop Valve and Dead-Weight Types

By Henry A. Cozzens, Jr.

The function of the safety valve is to act as a warning signal in case of excessive pressure and to reduce this pressure to the proper limit. Safety valves are generally made in three classes, namely, the lever, the dead weight and the pop valve, all of which have one feature—the valve opens outward and is held in place against the steam pressure by a weight or compressed spring.

The lever valve is simply an application of the third-class lever in mechanics, the weight being represented by the ball at the end of the bar and the power by the excessive pressure, the fulcrum being placed at the end of the bar, near the point of application of the power. To increase or decrease the efficiency of the valve the weight is moved to or from the fulcrum. The advantage of this type of valve lies in its simplicity, while its disadvantages are numerous. In the first place it can be easily overloaded, and when in charge of an incompetent person, it can have little to do toward the safety of a plant. It may also be easily jammed on its seat, rendering it ineffective. When the valve blows off it often fails to return to its seat and maintain a tight fit, so that numerous leaks result. On account of these defects the valve is not used so extensively and has been replaced by either the pop or dead weight valve, but mostly by the former type.

The dead weight valve is used in connection with marine boilers. Its construction is very simple, a weight being hung on the valve stem inside the boiler. This valve has a semi-spherical-shaped seat, so when the boat rocks the weight inside the boiler has a tendency to swing back and forth so that the steam cannot escape, owing to this method of construction.

The pop valve has a spring to hold the valve in position against the steam pressure and many designs have a lever by which the valve may be tested. In accordance with the rules and regulations of the United States Board of Supervising Inspectors all these valves have seats with an angle of inclination of forty-five degrees to the center line of their axis. In order that the valve at all times may have the same amount of pop, a knife-edge lip is placed about the pop chamber, which wears down in proportion with the valve seat. The adjustment of pop valves is accomplished by means of a screw placed at the top of the valve which either tightens or loosens the spring. To keep an incompetent person from tampering with the valve, a lock-up attachment is provided, or in some cases valves are so designed that they cannot be adjusted except by the use of a hollow wrench which is left in the possession of the chief engineer or some other responsible person. On many types the spring is enclosed in a shell so as to protect it from the effects of the steam. This type of valve may be easily taken apart and cleaned or repaired.

Safety valves should be direct-connected to the boiler by means of a separate pipe, which must be free from bends or elbows, and, when possible, should be attached without piping, to the steam dome. When using red lead in making connections it is advisable to see that none gets in the valve, as it often causes it to stick to the valve seat. Although a waste pipe is not recommended by most engineers, if it must be used, each valve must be piped separately to the open air, and when used horizontally it should be slanted so as to discharge all accumulating water.

Safety valves require as much care as any power plant apparatus and should be tested every day to see that they are in perfect working order. Valves are sometimes tested by lifting the lever or by the safer way of gradually increasing the boiler pressure. In the latter case the fireman should be near so that if the valve should fail to work there would be no danger to the boiler from too much pressure. Investigation should be made at once upon learning of the failure of a valve to operate. The trouble is generally caused by the seat being jammed down, or the spring may have been set too strong. Scale and gum from impure feed water often get in the valve and causes it to stick to its seat.

In designing the safety valve for a boiler it is a very important matter to have the valve so made that it is able to reduce the surplus pressure before it increases to a dangerous point. The area of the safety valve should be in proportion to the amount of steam to be discharged, which is equal to the generating capacity of the boiler under the best conditions. Since the generating power of a boiler depends on the fuel consumption, and the fuel consumption depends on the draft and grate surface, therefore the size of the valve will depend on the amount of grate surface and draft as will be seen on consulting the two following formulæ. Safety valve areas are generally figured as follows: For lever valves the area is equal to one-half square inch for each square foot of grate area, while spring-loaded valves have an area equal to one-third of a square inch for each square foot of grate area. Spring-loaded valves for water tube, coil and sectional boilers must have an area greater than one-sixth of a square inch for each square foot of grate area. The Philadelphia rule is as follows: Let G = the grate surface in square feet, P = the steam pressure by gauge, W = the weight of coal burned per hour and A = the area of safety valve in square inches. Then for natural draft $A = 22.5\ G \div P + 8.62$ and for forced draft $A = 1.406\ W \div P + 8.62$. The above rules are the most widely known and claimed to be the most accurate.

The safety valve may be set for the pressure at which it is to blow by two methods, calculation and experiment. With the lever valve the method is as follows: First find the center of gravity of the lever by balancing it upon a knife edge or some such article; then the following formulæ may be used. To find the area of the valve when the diameter is given, area $= 3.1416 \times d^2 \div 4$ or $.7854 \times d^2$. Let A = area of safety valve in square inches, $h$ = distance from fulcrum to center of gravity, $b$ = distance from center of valve to fulcrum in square inches, X distance of weight from fulcrum in inches, W = weight in pounds hung on lever, Q = weight of lever and valve in pounds and P = pressure per square inch on boiler. Then $X = APb - Qh \div W$, $W = APb - Qh \div X$ and $P = WX + Qh \div Ab$.

If the valve is to be set by experiment the weight should be

set about half way out on the lever and the pressure at which the valve operates should be recorded. If the pressure is too small the weight should be moved outward and other trials made until the proper place is reached. This place should be marked so that the same operation will not have to be repeated after cleaning and repairing the valve. The pop valve may be set in the same way except the tension on the spring is regulated.

The maximum effective lift of a safety valve has been reached when the valve lifts to such an extent that the area of opening at the circumference equals the area of the valve disk; any greater lift would not permit more steam to escape. In order that the opening of escape should equal the disk area, it has been found by calculation that the lift should be one-quarter the diameter of the valve.

## Synchronous vs. Induction Motors.

By Jacob Glogau.

As the synchronous and induction motors are most commonly used on alternating circuits at the present time, and as great differences will be found in the operation and efficieny of each type, the following detailed description of the operation of each type, including the extra apparatus used, construction, starting and speed of motors. the current taken, the power factor, accidents which may occur, reactions, if any, upon the generator, and lastly the conclusions which may be drawn after all these facts have been compared. may be found useful.

*The Synchronous Motor.*—When a synchronous motor is to be cut into the line a starting motor has to be used, or if the motor is of the self-starting type, a resistance or transformer has to be used to reduce the voltage of the line. An exciter also must be used to supply current to the field coils, thus necessitating the starting apparatus for the exciter, and, lastly, a friction clutch is required in many cases. The armature of the synchronous motor is practically constructed in the same manner as the armature of direct-current motors, the only difference being, that the coils are connected to collector rings instead of commutator bars.

To be synchronized the motor must be brought up to speed and then regulated, and the exciter supplying current to the field coils of the motor must be adjusted, so that the motor will be synchronized correctly. At this point the friction clutch is generally used to throw on the load. The torque or pulling power of the motor is very small before it is synchronized, and at the same time it is using an excessive supply of current, but when the machine is running at synchronized speed the torque is at its maximum.

The speed of the motor being constant, the current supplied to the motor depends upon the following conditions: First, the wave form of the transmission, which, if different from the wave form of the motor, will result in excessive current being used, and second, the regularity of the alternators. As the motor is synchronous, it endeavors to follow the speed of the generator, but if the generator speed changes, then the motor speed will also change, thus increasing the supply of current to the motor.

When a synchronous motor runs under favorable conditions such as similarity of the wave forms, there is hunting or imperfect synchronous running (caused by periodic increase or decrease in speed of the alternator and motor), the field current will be correct and the motor will operate at a high power factor.

In regards to the relation between the generator and the circuit, the synchronous motor can cause a great deal of damage. For instance, should a short circuit occur on a line the motor would act as a generator, which would increase the current and also increase the intensity of the short-circuit. If the operation required in starting the motor has been done incorrectly, damage will result, and if a load is put on the motor too quickly it will cause it to stop. Should the motor stop owing to the discontinuance of the current, it will not start up again when the current is resumed, but will have to be synchronized over again. If the electro-motive force is lowered, the motor would fall out of synchronism and stop. A heavy load, even were it applied for only a moment, will also stop the motor. Thus it may be seen what careful use a synchronous motor requires in order to operate in a satisfactory manner.

*The Induction Motor.*—The induction motor requires no extra apparatus to start it other than a switch and a transformer, which lowers the line voltage to the voltage of the motor. The revolving part has a primary winding and the secondary is short-circuited in the squirrel-cage type. There are no contacts, collector rings or brushes used. When a motor is to be operated it is started at a low voltage and allowed to speed up, then the line voltage is applied; the load of the motor being started by the motor. The torque of the motor is very strong at the start so that the maximum torque of the induction motor is greater than the maximum torque of the synchronous motor, and hence can be started under load. The speed of the induction motor is either constant or variable and the current used is proportional to the torque, it being independent of any action that may be caused by the wave forms and fluctuations of the generator supplying the line. The current of the induction motor is always a periodic current lagging behind the impressed electro-motive force which produces it.

The power factor is also proportional to the load and is not dependent upon the hunting of circuits and wave forms. Instead of reacting upon the generator and circuit in a dangerous form, it helps along the circuit, first by smoothing out the irregularities of the generator wave, and secondly, by smoothing the fluctuations of the generator.

The induction motor does not generate an electro-motive force, therefore, if the line becomes short circuited or the motor is disconnected from the circuit, no damage will be done when the motor is operating under all conditions which may occur on the line. If the current is interrupted the motor will stop, but as soon as it is resumed again the motor will start by itself.

In comparing these two types of motors it will be seen that the synchronous motor may be termed an active member of the circuit, as it is affected by the least change that may occur on the line or with the generator. While the induction motor operates and takes care of its own work under nearly all conditions and is not affected by the slight changes which may occur on the line or with the generator. The successful operation of the synchronous motor depends upon the regularity of speed, fluctuations of the generator and of the load, while the induction motor is not sensitive to these changes. The synchronous motor has to be cared for by skilled attendants

requiring much attention, while any common sense person can operate the induction motor.

In concluding, it will be seen that the induction motor is simple and reliable while the synchronous motor is complex and liable to many accidents, and that it would not pay a manufacturer, using motors, to install the synchronous motor, as it is not suitable for general distribution of power. Therefore, the best motor to use is of the induction type which does away with the attendance of skillful hands to operate them.

### All Boilers in the State of Massachusetts to be Under the Jurisdiction of the State Boiler Inspection Department.

During the last session of the Massachusetts legislature, a large number of bills were presented pertaining to matters affecting boiler inspection work. The committee to which all these bills were referred submitted to the legislature a new bill which was enacted into a law. This new boiler inspection law is drawn on very progressive lines and gives the state boiler inspection department jurisdiction over all boilers in the Commonwealth.

The new law takes effect October 1st, 1907, and provides that it shall be the duty of the board of boiler rules to formulate rules for the construction, installation and inspection of steam boilers, and for ascertaining the safe working pressure to be carried on boilers, to prescribe tests, if it deems necessary, to ascertain the qualities of materials used in the construction of boilers; to formulate rules regulating the construction and size of safety valves for the boilers of different sizes and pressures, the construction, use and location of fusible safety plugs, appliances for indicating the pressure of steam and the level of water in the boiler, and such other appliances as the board may deem necessary to safety in operating steam boilers; and to make a standard form of certificate of inspection.

The members of the State Board of Boiler Rules, who were appointed by the governor as provided in new law and confirmed on July 5th, represent practically all the persons interested in any way with steam boilers. The members of the board are:

Joseph H. McNeill, of Melrose, Chairman; William M. Beck, of Everett (for three years), operating engineer; John A. Stevens, of Lowell (for three years), representing the boiler-using interests; Frederic H. Keyes, of Newton (for two years), representing the boiler-manufacturing interests, and Robert J. Dunkle, of Boston (for two years), representing the boiler insurance interests. Chairman McNeill is also chief inspector of the boiler inspection department of the district police.

Chairman McNeill, of the Board of Boiler Rules, is a practical mechanic, having since boyhood been successively an apprentice, draftsman, journeyman, marine engineer, stationary engineer and master mechanic. In 1898 he entered the boiler inspection department of the Massachusetts district police as an inspector of boilers and examiner of engineers and firemen, and in 1906 he was appointed chief inspector of the boiler inspection department as the result of a competitive examination held by the Massachusetts civil service commission.

Mr. Beck, of the board, is widely known in engineering circles for the active part he has taken in legislative work during the last three years. He was first an apprenticed blacksmith, afterward he took up locomotive work with the Boston & Maine railroad, for 15 years he was employed as a stationary engineer, and for the last year and a half he has been with the Knickerbocker Ice Company as master mechanic on the Kennebec River.

Mr. Stevens is chief engineer of the Merrimac Manufacturing Company of Lowell and allied interests. He was indorsed to represent the boiler-using interests by representative manufacturers, including the Arkwright Club. He studied at the University of Michigan, and afterward served an apprenticeship with a western concern manufacturing marine and stationary engines. He took up marine engineering on the great lakes, and at 27 years of age was granted a license as chief of ocean steamers of unlimited tonnage. After seven years he came east and entered the employ of the International Navigation Company, being rapidly promoted to the position of first assistant engineer of the U. S. mail steamship St. Paul, which he resigned in 1896 to become chief engineer of the Merrimac Company, which had chosen him for the work of reconstructing its plant, which he has successfully carried out. He has now taken up the construction work of the company's mills in the south, as designing and consulting engineer. Mr. Stevens has been granted eight patents on boilers.

Mr. Keyes lives in Newtonville. He was indorsed by the New England Boiler Manufacturers' Association, representing all the leading boiler manufacturers of Massachusetts. He was graduated from the Massachusetts Institute of Technology with honors as a mechanical engineer. He was for a time engaged with large manufacturing concerns in Boston and Chicago, then returned to the Institute of Technology as an instructor in mechanical engineering, taking up laboratory and testing work for four and a half years. He is now general manager of the works of the Robb-Mumford Boiler Company at South Framingham.

Mr. Dunkle is a native of New Jersey. He embarked in the insurance business in the south, doing a large amount of boiler and liability business. In 1893 he came to Boston, continuing in the same line. In 1898 he became associated with O'Brion and Russell, and in 1901 he was admitted to a partnership, devoting his attention particularly to the boiler, accident and liability branches of the business.

Now that the law has been finally passed it rests with the above men whether boiler explosions in the State of Massachusetts shall be reduced to a minimum. Other states will watch carefully the workings of the new law and will judge it by the results produced.

### Gasoline Engines for Railroad Service.

An interesting innovation in railway passenger transportation in this country will be inauguarated next month, when, it is announced, the Union Pacific Railroad will place in service 12 gasoline rail-motor cars. The cars are intended for branch-line traffic, where the fast and frequent service required cannot be maintained by ordinary trains except at a loss.

The latest type of these cars developed at the Omaha shops of the Union Pacific makes 60 miles an hour with a 200 horse power engine, reaches high speed within six car lengths, and can be stopped within 120 feet. With these advantages the cars can be put on a much faster schedule than is possible with the steam locomotive.

The
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**Need of Hydraulic Engineering Refinement.**

Up until a few years ago one of the least progressive of the many branches of engineering was that of hydraulic engineering, particularly that branch which pertained to the design and construction of the hydraulic machinery. While water power has been utilized for centuries in all countries for the generation of power, the lack of efficient design was one of the most striking features of hydraulic plants. This was probably due to the fact that since nature so abundantly provided man with a power that could be easily harnessed, it was not thought necessary to utilize every drop of energy in the falling water. Consequently in many plants, it was usual, when a turbine plant was to be erected, to install one of the few stock sizes made by a manufacturer regardless of the particular duty which the hydraulic turbine had to perform.

To go back a dozen years when Niagara Falls was being harnessed for its first electrical transmission plant, so bare was the knowledge of hydraulic engineering in this country that designers from different parts of the continent were invited to draw plans so that the proper type of turbine could be constructed in this country. Since that time, however, owing to the marvelous electrical development which has been accaccomplished by electrical engineers, each piece of apparatus of any importance in hydraulic power plants is constructed to suit the particular conditions under which it must operate. To get the best efficiency for any given set of conditions, it is necessary that the proper design of the hydraulic turbine and electric generator depend, more or les, one upon the other, because in a hydraulic installation, the water pressure is a fixed physical condition as is also the minimum amount of water available. Therefore, to secure the highest efficiency and produce the most satisfactory results, with the head and quantity known, it is necessary that both the turbine and generator be designed with respect to the service and size of units required and in reference to the speed at which maximum efficiency is attained.

Of all the problems in connection with the construction and successful operation of a hydraulic installation, the most troublesome has been the proper regulation of the speed of the water-wheel with any given set of conditions. The rotating parts of the generator and turbine, the relief valve, the penstock and draft-tube, are as much a part of the governor as the fly-balls themselves. The greatest difficulty in hydraulic engineering is that of hydraulic inertia. Water moves sluggishly through long and level pipes and its velocity does not change promptly enough for good governing unless the waterways are properly designed. It takes a certain time to get a water column to change its velocity, such as the flow of water through a penstock, and the longer the time constant of the water column, the more difficult it is to get accurate governing, because no matter how efficient the governing mechanism may be, by the time the water has changed its velocity to meet the new conditions, the conditions may have again changed and the governor will be struggling with conditions that are just the reverse of what it is expected to remedy. When this is not the case, the governing of the wheel may be continued up to the time at which the wheel is affected by the change of conditions, which reacts on the governor, causing it to again change its position, owing to the fineness with which it has governed the first change of conditions. This causes the

governor to "hunt" and gives a slow oscillation of the speed about the desired mean speed it is striving to maintain.

To overcome many of these governing difficulties, it is necesary that the movement of the gates be comparatively active, but this tends to bring severe strains on the mechanism and gates due to the variations in pressure caused by a change of velocity, and unless these conditions are counteracted by air-chambers, stand-pipes, etc., the very act of governing will be dangerous and if the parts are made very heavy to withstand these strains, there is the added difficulty of using considerable power in the governor to move them. If accurate governing is to be attained, it is also very necessary that the regulating gate should be close to the wheel and the penstock should be as short and vertical as possible, the ideal condition for governing being attained when the wheel is located in an open flume.

The design of the turbine is also a factor in governing it. Not all water-wheels are governed with the same ease, as many of them are so designed that the unbalanced pressure which is allowed to come upon the gates makes it impossible to attain anything like a proper degree of sensitiveness and stability.

The waste of water energy has not been considered to such a degree of refinement as the waste of heat energy, but with the advent of 15,000 horse power turbines and the diminishing number of water powers available, it is just as important to get the last drop of power out of a pound of water, as it is to get the last drop of heat energy out of a pound of coal.

—o—

**Discrimination Against Engineers.**

It is said that for some time before a volcano erupts, or an earthquake happens, there is a rumbling noise which presages the event which is to follow. To the trained ear, it means caution and removal from the scene of the disturbance, but, generally, many of the signs are not heeded. As we put our ear to the ground, we hear a distinct rumbling from the State of Massachusetts. As a general rule, the Massachusetts engineer loves to write, but when he is discussing the license law as it exists today in the Bay State, there is much rumbling, and there are not very many adjectives left in the dictionary which have not been used. The adherents of the law clothe their admiration for it with a festoon of delightful words, while those who think the law unjust often state their thoughts in words unprintable, and so the rumble may be harmonic, or it may be out of phase, as it were.

The value of any law, whether it be a license law or any other kind, is the proper observance of its requirements. Too often a law is more honored in the breach than in the observance, which makes it despised by those who must live under it. Whether the Massachusetts law is properly observed or not, it remains for the great body of engineers in that State to say. That it does not have the respect of many engineers is indicated by the numerous letters which we have received upon the subject. In fact, a number of engineers go so far as to say that it is unconstitutional.

The point is this: If the law is constitutional and is considered a good law by the majority of engineers in that state, its requirements should be strictly adhered to; but, if it is not constitutional or is obnoxious to the engineers having the best future of the engineering profession at heart, then its enactments should be tried out in the courts, or should be changed.

If, as has been charged, the law was framed for the benefit of the few, then its requirements are untenable as no law can permanently stand that has not behind it the consideration of the majority. Every law, for the time being, when it is first enacted, will work some injustice to the few, but if it has behind it those strong sentiments of right and equality, even those temporarily injured may be the first to see its great general value, and the measure may bring a blessing to them in disguise. Nobody probably knows better than the engineer that nearly every piece of machinery for the saving of labor has been combatted by labor, but the ones who most profit by it in the end is the laboring man himself.

The engineers are making a great mistake if they foster laws which will put a Chinese wall around their profession. A square deal for all should be just as applicable when engineers are taking examinations, as it is now being applied under pressure to the public service corporations, due to the popular outburst against discrimination, which has been going for some years.

A howl has recently gone up all over this country, because the government decided that one of the requirements of the chief engineer for the post-office building, at Chicago, Ill., should be that the applicant must be a graduate of a technical institute or engineering college. Engineering societies in various parts of the country have adopted resolutions protesting against this unjust discrimination as it effectually prevented a large number of operating engineers who were applicants, from taking the examination.

It does not appear so very different to us, however, whether this requirement is actually printed in the application blank, or whether the examiners would have asked questions which only engineering school graduates can answer. It is only a difference between tweedledum and tweedledee, and many of the engineering societies who are protesting against the drastic action taken by civil service commission at Chicago, are supporting an administration of the license law which asks questions that only college graduates can answer.

It must be expected that, on account of the comparative youth of the license laws, some mistakes will be made in its administration, but as time goes on, these errors in the application of what is a very good thing to the engineer and public at large, should be weeded out so that each engineer may have a just and rigid path to travel through. If so, less rumbling of an impending storm, which may eventually upheave the license laws will be heard.

—o—

Recent experiments made by the Geological Survey demonstrated that far more power can be obtained from bituminous coal when used in gas producers than when it is consumed in the ordinary way. For the production of one electrical horse-power-hour, in the producer gas plant, there were required on an average of 1.50 pounds of dry coal, while to produce the same result in the steam plant it required on an average of 3.61 pounds of dry coal.

# LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

## The Plunger Elevator.

EDITOR THE PRACTICAL ENGINEER:

Continuing my article on "The Plunger Elevator" in the March issue, I would suggest that especial care be given to the shoes and rails, as on them hinges a great deal of the trouble with the plunger elevator; for instance, if the shoes on one side should wear faster than those on the other, the car will be thrown over to that side, and if left go too long, it will cause the plunger to wear the packing on that side. The plunger itself would be worn out if true, and, after a short time, it would be almost impossible to keep the packing tight, and consequently there would be a considerable waste of power.

The car on a plunger elevator must be kept absolutely plumb, if good results are desired, more so than on a hoisting elevator, for it can readily be seen that if the car is not running plumb, there will be undue friction and wear on the plunger and packing.

The way to plumb a car is to put shims back of the shoe receptacle, and sometimes, if the car is binding, the bolts that are holding the car to the plunger may be loosened and the car will then center itself, if not too badly out of line. On some plunger elevators babbitt shoes are used, but I find that a good hard wood shoe is as good, if not better. It is cheaper and the shoes can be kept in better condition, as it does not cost much to renew them, as they can be made at any planing mill and sawed off in suitable lengths.

The edges of the rails must be filed as soon as they commence to be sharp, as they will cut away the wooden shoe quickly if not rounded off.

After repairs to operating valves or plunger packing, there will always be more or less air in the plunger cylinder, which if not allowed to escape, will cause a very disagreeable bouncing of the car. This air should be worked out of the system, by means of a small pet cock located in the cylinder just below the stuffing box, before admitting passengers to the car.

Dorchester, Mass. C. A. H.

## Calculations for Finding Diameters of 2500 H. P. Compound Engine.

EDITOR THE PRACTICAL ENGINEER:

In the June issue of THE PRACTICAL ENGINEER I read with interest the article, "Recent First-Class Massachusetts License Questions," and also your own editorial, "Unfair Examination Questions."

I have noticed several times in previous issues of THE PRACTICAL ENGINEER, questions which, in my mind, are rather stiff for the usual every-day engineer. Such questions as correct ratio and sizes of cylinders, economical steam pressure, methods of establishing theoretical expansion curves, thrust on guide shoe and numerous others, are questions upon which the authorities, designers and builders are at variance. By comparison, between the catalogues of different manufacturers, we find that for a stated horse power the various factors, such as cylinder proportion, speed, stroke, allowable pressure, etc., are far from being in accord. I would like to know if the knowledge requisite for the answering of such questions is necessary to the majority of engineers in the discharge of their duties? I believe that every engineer should have a sound understanding of the action of the steam in the cylinders, indicator cards and the boilers, and be able to make the rough calculations which are likely to occur around a power plant. But to require the ordinary engineer to pass an examination dealing with such questions as the above mentioned and many others of intricate character, is, to say the least, expecting too much. However, an engineer who seeks to advance himself by constant study and application to his books and trade journals, is worthy of praise and is likely to rise to a higher position, and probably increase the amount of that most essential piece of paper—the pay cheque.

As regards the questions relative to the cross-compound condensing engine, the following are required: Diameter of high-pressure cylinder, diameter of low-pressure cylinder, length of stroke, number of revolutions, economical pressure, initial, terminal and mean effective pressurse of both cylinders; also economical points of cut-off.

Let us assume a boiler pressure of 165 pounds absolute, with a drop of five pounds from boiler to engine, consequently we have an initial pressure of 160 pounds absolute at high pressure cylinder. Allowing the cut-off to occur in each cylinder at ¼ stroke, there will be four expansions in each cylinder, or a total of sixteen expansions in the two cylinders. To obtain terminal pressure in the high-pressure cylinder, the initial pressure is divided by the number of expansions in that cylinder, which in this case is $160 \div 4 = 40$ pounds. Since the initial pressure in the low-pressure cylinder equals the terminal pressure in the high-pressure cylinder, in the theoretical engine, we have a terminal pressure in the low-pressure cylinder of $40 \div 4 = 10$ pounds, or by taking initial pressure of high-pressure cylinder and dividing by total number of expansions in the engine, we have $160 \div 16 = 10$ pounds.

The mean effective pressure of the high-pressure cylinder is readily found by the formula: $P \times (1 + \text{hyp. log. of } R \div R) - p$., in which $P$ = initial pressure, $R$ = ratio of expansions, and $p$ = back pressure. The value of $R = 4$ and the hyp. log. of 4 is 1.3863. Then the M. E. P. $= 160\ (1 + 1.3863 \div 4) - 40 = 55.45$ pounds. We will assume the engine is condensing to two pounds back pressure, or 26" vacuum. The initial pressure of the low-pressure cylinder being 40 pounds, then the M. E. P. of the low-pressure cylinder is $40\ (1 + 1.3863 \div 4) - 2 = 21.86$ pounds.

In a well-proportioned engine the resultant power should be so divided that each cylinder will perform one-half the required amount, which in this case would be 1,250 horse power. A reasonable piston speed would be 820 feet per minute, realized by a 5-foot stroke, with 82 revolutions per minute. We now have the following factors which assist us in determining

the size of the cylinders. Piston speed, 820 feet per minute; M. E. P. of high-pressure cylinder, 55.45 pounds; M. E. P. of low-pressure cylinder, 21.86 pounds, and 1,250 horse power of each cylinder.

In determining the size of the cylinders the well-known horse power formula, PLAN ÷ 33,000, is used, and by substitution we have area = 33,000 × H. P. ÷ PLAN. In taking the high-pressure cylinder first, we have

$$\frac{33{,}000 \times 1{,}250}{55.45 \times 5 \times 2 \times 82} = 907.2$$

square inches. The diameter is then equal to 33.09, or 34 inches. In the low-pressure cylinder the area is equal to

$$\frac{33{,}000 \times 1{,}250}{21.86 \times 5 \times 2 \times 82} = 2301.22$$ square inches. The diameter is then equal to 54.13, or 54⅛ inches.

The data thus obtained is diameter of high-pressure cylinder, 34 inches; diameter of low-pressure cylinder, 54⅛ inches; length of stroke, 5 feet; numbe rof revolutions, 82; boiler pressure, 165 pounds; initial pressure in high-pressure cylinder, 160 pounds; terminal pressure in high-pressure cylinder, 40 pounds; initial pressure in low-pressure cylinder, 40 pounds; terminal pressure in low-pressure cylinder, 10 pounds; M. E. P. in high-pressure cylinder, 55.45 pounds; M. E. P. in low-pressure cylinder, 21.86 pounds, and vacuum, 26 inches.

Had an allowance been made for clearance, some of the results would have been slightly different. As an illustartion, take the terminal pressure in the high-pressure cylinder and allow 4 per cent. clearance, which would equal 2.4. Then 60 + 2.4 = 62.4 total volume, and 15 + 2.4 = 17.4 total volume at point of cut-off, which gives us the following proportion: Total volume: volume at point of cut-off = initial pressure: terminal pressure. Therefore 62.4: 17.4 = 160: terminal pressure, giving a result of 44.61 pounds terminal pressure in high-pressure cylinder, instead of 40 pounds as previously found.

Germantown, Pa. R. T.

### The Value of D.

EDITOR THE PRACTICAL ENGINEER:

The following is an article on the value of D, in one of the many formulas given to engineers for finding the area of a circle, as applied to boiler heads, etc.

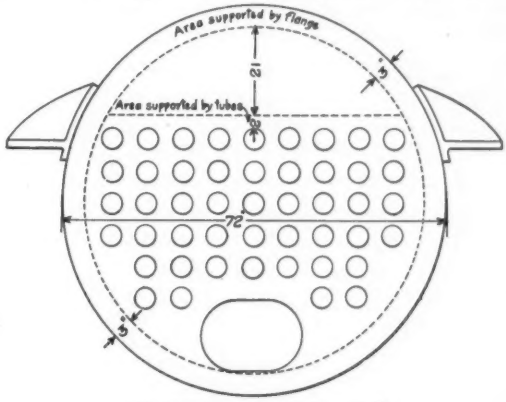
To illustrate, let us take a boiler 72″ in diameter, in which the distance from the top row of tubes to the shell is 26″. Let A equal area of segment, *h* equal height of segment, and D equal diameter of boiler. Thus we have

$$A = \frac{4h^2\sqrt{D}}{3\sqrt{h}} - .608$$

Whenever the exponent appears above a number, it means that the number is to be squared if the figure is 2, or cubed if the figure is three, and not simply multiplied by 2 or 3, as some misunderstand it.

The height of the segment, or distance from the top of tubes to shell, is to be multiplied by itself and the square so found multiplied by 4, and this product multiplied by the square root of the diameter. Now divide the result by 3 times the square root of the height, and subtracting from this product the constant .608, gives the desired area.

As the head is flanged, this flange had sufficient strength to safely sustain the head for 3″ toward the center of the boiler all around the head, as shown in illustration. The tubes also act as stays supporting that portion of the head in which they are placed, and support for 2″ along their top, as shown in




Illustrating the Value of D.

illustration. The flange and head together being capable of supporting 3″, the height of the segment to be carried by the braces is reduced that amount. This 3″ plus the 2″ that the tubes support subtracted from the original 26″ gives 21″, the value of *h*. Since the flange supports the head for 3″ in all directions this reduces the original diameter 6″, or 3″ on each side. Therefore the value of D in this case is not 72″ but 72″ minus 6″ or 66″.

Lawrence, Mass. A. W. B. E.

### What Makes a First-Class Engineer?

EDITOR THE PRACTICAL ENGINEER:

With your permission I will endeavor to answer Mr. Mason's very suggestive letter which appeared in the March issue. Judging from the articles which appear from time to time in your paper under the name of Mr. Mason, I assume that he has had both practical and theoretical experience, and therefore I will give him a few reasons for my opinion on the first-class license.

Mr. Mason, with some other readers of THE PRACTICAL ENGINEER, has interpreted my original letter entirely different to the view with which it was written. However, in looking over my letter, I will admit that they had just ground for doing so. My intentions were not by any means to sneer or belittle Mr. Scott, as I assumed that he was really taking a hypothetical case. Neither did I intend to question the amount of information to be obtained from catalogues on specialties but simply attempted to express my opinion of the first-class license.

My idea of an engineer finds full expression in the advice given to stationary engineers by Capt. Crawford, in the November issue, but how far short of that standard some engineers are, the correspondence and query columns of any technical journal will answer. I suppose it is simply a question of what opinion a man holds on the necessary qualifications of a first-class engineer, or as Mr. Mason expresses it, a "real engineer."

I quite agree with Mr. Mason when he says that it requires years of training to become a first-class mechanic, and that all first-class mechanics are not first-class engineers. I agree with him that some men will never become engineers, but I certainly cannot agree with him when he makes the statement that it is quite possible to become a first-class engineer without ever having served a day in the machine shop; that is if he refers to operating engineers, as my experience both afloat and ashore has taught me differently. If Mr. Mason refers to designing engineers and draughtsmen, which we grant to be first-class engineers, he will find that they have to serve an apprenticeship in the drawing room if not in the shop. It matters not what amount of natural talent a man may possess, unless he is given opportunity and instruction in developing those talents, combined with a determination on his part to overcome the various obstacles and counter attractions which crop up in all paths of life, he will never amount to anything. In how many cases do we find such opportunity or possibilities of instruction in either the practical or theoretical part of engineering, given to the man who comes from the fire-room. The consequence is that he crams just enough to pass the examination, and so becomes a full-fledged engineer. Therefore, I beg to differ with Mr. Mason when he says that engineers are born and not made.

When it comes to overhauling machinery, and more so in case of a break-down, I know which of the two men I would rather have, the man who came from the shop or the man who has come from the fire-room. An incident which comes to mind illustrating this point, was the case of a hot crank-pin which burnt the white metal in the brasses to such an extent that it was necessary to chip the cast-iron liners, or parting pieces down ¼ inch to adjust the brasses again. The engineer of the watch took one liner and the oiler, who had been through the shops, took the other, with the result that by the time the oiler had his liner chipped down to the required dimensions, the engineer had his about half chewed down (for it certainly was not chipped), and in two pieces, which the oiler had to repair. When spoken to about his carelessness he said that where he was employed before they always had the shop men do all such work. This is only one of the many incidents in my experience of shop men versus fire-room men in practical work.

When we come to theoretical work, or, as Mr. Mason calls it, "the ability to see into things," some men are even worse, as I think the following will show. A man who is employed in a certain plant as wiper, with the intention of some day becoming an operating engineer, asked the engineer why one cylinder of the compound engine was larger than the other. The answer he received was, "Because the steam would not flow from one cylinder to the other if such were not the case," and this answer was given in all good faith by an engineer of 10 years' experience. Now I am not sneering at the parties concerned in the foregoing incidents, but simply relating facts which have come under my personal knowledge. An incident related in THE PRACTICAL ENGINEER concerning the change of motion of a slide-valve engine, illustrates more forcibly than those I have just related, the advantage of a shop-trained engineer. Had the engineer been a practical man, there would have been no need to send to the shop for a mechanic to simply change the position of the eccentrics; and, surely, Mr. Mason could hardly consider either of the men whom T. S. mentions, in the March issue, "real engineers."

If we consider the purely theoretical man we will find some of them who cannot "see into things" as quickly as one would suppose. I know of an instance where a government college graduate in taking an examination for promotion, misapplied what he himself termed "Hutton's Well-Known Law on Skin Resistance of Ships," by designing a ship of certain speed and installing machinery of just sufficient power to overcome the skin resistance of the ship while being driven at the required speed. What he should have done was to install machinery of sufficient power to drive the ship the required speed, and also overcome the skin resistance, and it's needless to say the design never got beyond the drawing-room stage.

I believe the examination for a first-class license should cover a much broader field, and while I do not claim that being a mechanic is the *most* essential requirement, I *do* claim that it is *one* of the many essential requirements of a first-class engineer.

In marine as well as in stationary engineering we find that "real engineers" are just as conspicuous by their absence. That this fact is recognized by the U. S. inspectors is evident by the granting of limited licenses to men whom they know have not the necessary qualifications, either practically or theoretically, to take charge of high-power ships. On such a ship a limited license man would find himself very much "at sea" in more ways than one, so the inspectors grant them a license suitable to their limited knowledge, which, in many cases, is indeed very limited.

In concluding, I would also assure Mr. Mason that I have neither desire nor intention that the readers of THE PRACTICAL ENGINEER should think of me otherwise than simply an operating engineer.

San Francisco. GOLDEN WEST.

## Operating Generators in Parallel.

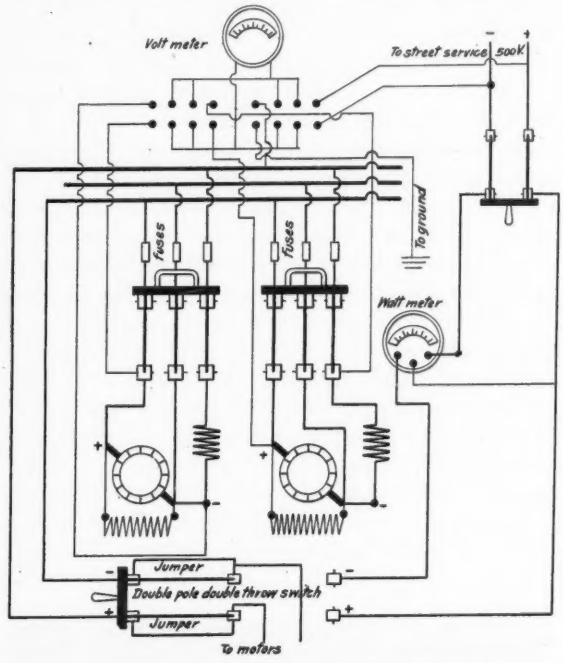
EDITOR THE PRACTICAL ENGINEER:

I have read with much interest and profit the article, Compound Generators in Parallel by S. A. Fletcher, in the March issue of THE PRACTICAL ENGINEER, and finding my ammeter shunts and circuit-breaker on the same side as my equalizer, I have changed the shunts and will also change the breakers, as soon as possible.

There is another method of operating generators in parallel not mentioned by Mr. Fletcher which I will describe. We have an isolated 500-volt plant, consisting of two 75 K. W. generators and 36 motors, with a street service cut in for break-down, noon, and night service. Until recently we used to shut down the motors before changing over, but at the present time we throw our machines in parallel with the street lines before opening our switches, thereby making the change without disturbing in the least the operation of our factory. The cost of our street service being small, we are now able to shut down our Corliss engine during light load periods, which we did not do previously because of the annoyance caused by the interruption.

In the accompanying illustration it will be noticed that there are two jumpers on the main double throw switch which bridge the plant side of the switch at all times. It will also be noticed that the street lines are connected to one of our volt meter

connections, which was formerly used as a ground detector on our negative line. In making the change we adjust our voltage to as near that of the street voltage as possible, then throw our main double throw switch over on the street side, the jumpers keeping the circuit closed, and instantly pull both of our machine switches. The other change, from the street back to the plant is, of course, just the reverse. While it is not advisable to throw too much of a load on or off the generators or engine, we have handled 120 amperes easily.




Arrangement for Operating Generators in Parallel

Of course care must be exercised with the switchboard as the jumpers being on the main switch, the street current is on one side of the machine terminals all the time the plant is shut down, so no meddling with the switchboard should be allowed. However, with a little care no trouble or difficulty will be experienced.

West Orange, N. J. A. J. Z.

### A Peculiar Experience with Engine.

EDITOR THE PRACTICAL ENGINEER:

I read with much interest in the April issue, A. L. H. T.'s article entitled, "A Peculiar Pump Trouble," and I think it a good illustration of how a small foreign body will sometimes exert great resistance. For instance, last August I was yarding logs in a camp on Hood's Canal, Puget Sound, with a pair of 9" x 10" engines running under a boiler pressure of 140 pounds. This engine had only one pinion doing its work from the crank shaft. The key of this pinion had been causing considerable trouble before I took charge, and the engineer had slipped a brass shim under the key on which the key was then driven. The shim was quite thin, not more than 18 or 20 gauge; but the key still continued to back out, and when the key came out, it would leave the pinion loose and perfectly free on the shaft. One day the key worked out, when the keyway was down, and a corner of the shim, not more than an inch long, was caught by the keyway and clipped off. The engine continued to pull, and when I had stopped it and attempted to put the key back, I could not do so, as the pinion had frozen fast on the shaft with the keyways about 2½ inches apart.

Thinking that I could release the pinion from the shaft, I started the pair of engines at a speed of 400 revolutions per minute, and notwithstanding that when the friction was thrown on and the engine brought to a dead stop within a few revolutions with the throttle wide open, the pinion did not move. This strain was put upon the pinion more than a hundred times a day, as the ground was very rough and the logs in bad places. When I left the camp, the pinion was still doing the hardest kind of work with no key to secure it to the shaft.

Seattle, Wash. W. Y.

### Loose Lining Caused Pump Trouble.

EDITOR THE PRACTICAL ENGINEER:

One of the most puzzling pump problems that ever came to me for an immediate solution, happened some years ago in a large steam plant where I was then employed.

We had three single Knowles pumps to supply the boilers with feed water, two of them with 5-inch water pistons and the third had a 10-inch piston. The water cylinders were brass-lined with soft packing in the piston, which was set out with the usual rings and screws. The large pump, running in connection with one of the small ones, would keep things going nicely, but when the boilers were working hard the two small pumps, without the large one, were hardly sufficient. sufficient.

One day the boss fireman rang the "trouble bell," and, upon going down to the boiler-room, informed me that the large pump would not work. We put both the small pumps to work, and then started an investigation. When the piston was traveling towards the steam end the pump would move all right, but when it traveled in the opposite direction it moved with much difficulty. The first thing I did was to remove the cover of the water end of the pump, but found everything all right as far as I could see. I then took off the cover of the steam chest, thinking that the steam valve might be out of place, but everything there was firm and all right. Replacing the cover of the steam chest, I next removed the steam cylinder head and follower-plate, but found nothing wrong. Just at this time, to add to our trouble, the fireman ran in and informed us that the water was nearly out of sight in the boilers. The small pumps were then running as fast as it was safe to have them go, but I opened the valves more and ran them a little faster.

We tried the large pump again with the same result, and thinking it possible that some of the water valves might be out of place, I removed all the hand-hole covers, but the valves were all right. Again removing the cylinder head on the water end I found as before, everything all right. What to do next was the problem, everything had been examined and nothing had been found wrong. After closing the pump up once more and starting it, I thought I could hear a very slight but unusual thump in the water cylinder. I stopped the pump, removed the head once more and then located the trouble. The brass-lining had become loosened in the cylinder, and when the piston was moving toward the water end it took the lining

with it, and thus closed the ports in that end. I put the lining back in place, peened the ends into the ports and went ahead all right, although the water was just out of sight in the boilers and the firemen, as well as myself, were getting rather nervous.

Very shortly after this we put in another large pump in place of one of the small ones, and so had no more such anxious half hours as that just described.

Methuen, Mass. S. J. S.

### Is the Massachusetts License Law Unlawful?

EDITOR THE PRACTICAL ENGINEER:

I read with much interest, your editorial on the subject of examination questions in the June issue, and also noted on another page the list of recent questions asked in Massachusetts, which reminded me of others which have been given from time to time in this paper and the comments which have followed their appearance.

Massachusetts is commonly understood to be the scene of many unfair examinations, and from what I have seen and heard during several years' residence there and in a neighboring state, I am sure that the supposition does the Bay State no injustice. The law was bad enough at first, but has been "perfected" year after year, until at present, the field is practically closed to all except those who now hold licenses; which, of course, was the end and aim from the first. But selfishness seldom prospers to the extent that it seems to have so far in this case (though with all their laws and amendments, I have never been able to see that wages are any higher there than elsewhere in New England). The larger part of that law is, without a doubt, unconstitutional, and it has been pronounced so in other cases, and it is only necessary for some fellow, who has been "done" by one of those funny examinations, to get mad enough to knock the whole thing higher than Gilroy's kite. Of course, the general opinion would be that anyone who would do anything like that would be a mean scamp, but I am convinced that it would be a just punishment for those responsible for the present state of affairs.

Providence, R. I. R. J.

### Rough Calculations for Finding the Number of Pounds of Steam Required by an Engine per Horse Power per Hour.

EDITOR THE PRACTICAL ENGINEER:

In one of your issues there appears a letter from Charles J. Mason with the above heading, in which he replies to the following question: "How many pounds of steam will a 15¼" x 24" engine, running at 177 revolutions per minute, 90 pounds boiler pressure, cutting off at 1/3 stroke, exhaust per hour?" After mathematically working out this problem, he gives as the answer 4619.43 pounds of steam exhausted per hour. Certainly Mr. Mason presents the solution of this question in a very peculiar and unsatisfactory manner.

In the above question, the 15¼" x 24" engine makes 177 revolutions per minute at 90 pounds boiler pressure, and cuts off at 1/3 stroke; or, in other words, the steam is admitted in the cylinder for a length of eight inches. Now for every stroke of the engine there is required a volume of steam in cubic feet at a pressure of 90 pounds by gauge, or 105 pounds absolute pressure, equal to the area of the cylinder in square inches, multiplied by the length of the stroke to the point of cut-off in inches and the product divided by 1728; or,

$$\text{Area} = 15.25 \times 15.25 \times .7854 = 182.65 \text{ sq. in.}$$

$$\text{Steam required} = 182.65 \times 8 = 1461.20 \text{ cubic in.}$$

$$= 1461.20 \div 1728 = .8456 \text{ cubic feet.}$$

At each stroke there is admitted .8456 cubic feet of steam at 90 pounds gauge pressure and as the engine makes $177 \times 2 = 354$ strokes per minute and $354 \times 60 = 21240$ strokes per hour, then $21240 \times .8456 = 17960.5$ cubic feet of steam per hour. Referring to a table similar to Mr. Mason's, we find that one cubic foot of steam at 90 pounds gauge weighs .2414 pounds; then $17960.5 \times .2414 = 4335.67$ pounds of steam furnished to the engine per hour. This is about 285 pounds more than Mr. Mason exhausts. I would like him to explain how he manages to exhaust more steam per hour than the engine receives.

At the end of his letter, he makes the following statement: "Suppose the engine is developing 200 horse power, then by taking an even number say 4620 pounds; then $4620 \div 200 = 23$ pounds of steam per horse power. Make an allowance of 25 per cent. we will have an approximate 30 pounds of steam per horse power per hour, which is about what could be expected from the kind of engine in the problem. Will Mr. Mason kindly explain what he means by making an allowance of 25 per cent. I have shown how much steam is supplied to the engine and I certainly see no reason to increase this 25 per cent. If the exhaust steam is to be increased 25 per cent. I would like to know how this can be done with the conditions of the problem remaining the same.

New Haven, Conn. J. W.

A. H. Francks J. A. Best A. M. Plummer
R. S. Peterson W. S. Price

**Committee of Atlantic City Enginers in charge of the entertainment of the Delegates to the recent Convention of the American Order of Steam Engineers**

# QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

### Questions M. T. M. About Good Boiler Performance.

EDITOR THE PRACTICAL ENGINEER:

Having become interested in the article "Good Boiler Performance," I would like to ask M. T. M. to kindly answer the following questions:

1. What is the working pressure on these boilers which he mentions?

2. How much coal do they burn per hour, and what kind of coal?

3. What is the temperature of the feed water, and how is it heated?

4. Have the steam lines to the engines separators in them?

5. Is all the condensation returned to the boilers, and, if so, how?

Like M. T. M., I think the performance of these boilers unusual.

Phila., Pa. J. B. L.

### Monocyclic or Three-Phase System.

EDITOR THE PRACTICAL ENGINEER:

Will you kindly explain the uses of a monocyclic generator, and when is it preferable to a three-phase machine? We have a large power load at our factory, and I am told that a monocyclic system will not do.

San Francisco, Cal. R. F. T.

The monocyclic system is a single-phase system primarily intended for the distribution of lights with an incidental load of motors. The lighting load is entirely connected to one single-phase circuit, and the motors are started and operated from this circuit with the assistance of the teazer wire.

The three-phase system is more simple, as it is a balanced system with approximately equal currents in the three legs of the circuit. The primary purpose of the system is distribution of the power. It, therefore, may be expected to give the best service where the power circuits constitute the greater proportion of the load.

In connection with high tension power transmission, if the one-phase system supplies one-phase step-up transformers and is properly grounded, it will require about the same amount of conducting material as a three-phase system. In comparison with the three-phase system, the one-phase requires fewer insulators and less expense in stringing the wires. Moreover, by taking advantage of the ground as a return circuit, the single-phase system can be operated in emergencies under conditions which would render the three-phase system inoperative, thus making the necessity for a duplicate line less in a single-phase system than with the three-phase arrangement.

### Load Factor of Plant.

EDITOR THE PRACTICAL ENGINEER:

What is meant by the yearly load factor of a plant? Our plant runs 66 hours a week, and we have about 750 kilowatts average load, the rated capacity of the generators being 1200 kilowatts.

Cincinnati, O. A. K. S.

The yearly load factor of a plant is the ratio of the actual number of kilowatts output of the plant to the possible output of the plant if it run at its rated capacity, 24 hours a day and 365 days a year. For instance, in the above problem, the total kilowatt output of the plant per year is $750 \times 66 \times 52 = 2{,}574{,}000$ kilowatts. The possible output for the year could be $1200 \times 365 \times 24 = 10{,}512{,}000$ kilowatts, so that the yearly load factor may be said to be 2,574,000 divided by 10,512,000 or 24.5 per cent.

### Amount of Water in Tank.

EDITOR THE PRACTICAL ENGINEER:

I would like to have you give me the correct answer to the following problem: How many gallons of water in the first inch of a tank 17 feet 10 inches long and 65 inches in diameter, the tank lying on its side.

San Francisco, Cal. F. T. S.

By the use of a table of segments, it is found that the area of a segment of a 65-inch circle, one inch high is 10.81 square inches; multiplying this by the length of the tank, 214 inches, gives 2,313.34 cubic inches as the amount of water in the tank. As there are 231 cubic inches in a gallon, there will be 10.01 gallons in the tank when the water is one inch high.

### Setting Valves on Greene Engine.

EDITOR THE PRACTICAL ENGINEER:

Kindly give me a method for setting the valves on a Greene engine running non-condensing.

St. Louis, Mo. F. R. G.

The steam and exhaust valve stem crossheads and slides have marks (or should have), which come opposite each other when the valve is opening. The governor rod is adjusted so that tappets in sliding bar are down on bottom when governor is at its highest point of travel. Steam valves should each have 3/16" lap when full closed and dash pots are bottoming. The toe sockets are then supposed to be plumb. Eccentric rod should be lengthened or shortened (better do it when cylinder is hot on account of expansion), so as to make the tappets of sliding bar travel by the toes 1/16" more at the front than at the back end. The toes may be varied slightly at either end of cylinder to equalize the cut-off. Lowering either toe makes the cut-off later for that end of the cylinder. Toes should be of such height as to just clear the tappets when the latter are down on bottom, in order to stop the supply of steam when governor is way up or stop motion operates.

Steam eccentric is then set so as to give about 1/16" lead opening to each steam valve when engine is on center. In regard to exhaust valves, the right and left connections from exhaust rockers to exhaust crossheads should be adjusted so as to give equal laps to exhaust valves when full closed, 3/16" lap for 12" cylinders, 5/16" lap for 14", 16" and 17" cylinders, 7/16" lap for 20" cylinders and 5/8" lap for 26" cylinders. The exhaust eccentric should be set so as to close exhaust valve 2½" before the end of stroke for 12" cylinders, 3" for 14", 16" and 17" cylinders, 4" for 20" cylinders and 6" for 26" cylinders, on non-condensing engines. In order to get the best results, the valves should finally be adjusted by the indicator cards.

## The Twelfth Annual Massachusetts State Convention of The N. A. S. E.

Engineers from all parts of Massachusetts assembled in New Bedford, Mass., on July 12th and 13th for the purpose of attending the Twelfth Annual Convention of the National Association of Steam Engineers of that State. The sessions were held in Odd Fellows' Hall, and the banquet, which is always a feature of the convention, was held on the fifth floor of the same building.

The convention was called to order at noon on July 12th by F. W. Carter, Chairman of the Convention Committee, who introduced as the first speaker, Samuel Higham, who officiated in the absence of Mayor Chas. S. Ashley, who could not be present. He spoke in favorable terms of the benefit the N. A. S. E. has been to Massachusetts and welcomed the delegates to New Bedford with a great deal of pleasure. The next speaker introduced was Theodore N. Kelsey, the National President of the N. A. S. E., who spoke of the growth of the organization in general, particularly in the States of Massachusetts and Pennsylvania. He congratulated the Massachusetts Association on their innovation this year in having the Ladies' Auxiliary entertain the visiting ladies. It is the first time this has been attempted and from the success the scheme met with in New Bedford, President Kelsey predicted that it would become a permanent feature in all State associations, as the social side of the organization has been growing steadily of late and he has found in those associations where ladies' auxiliaries are maintained that the strength of the organization seems to be aided.

Senator Wm. J. Bullock was next introduced. He confined his remarks mostly to a short sketch of the legislation during the past twelve years that concerns the stationary engineer. He complimented the organization upon the efficiency and tact of its Legislative Committe, to whose good work much of the favorable legislation, now in force, is due. Senator Bullock suggested that the convention, either at its present convention or at some future convention, take into consideration the abatement of the smoke nuisance, and he expressed the belief that with effective co-operation between engineers and legislators, this nuisance could be eradicated. National Vice-President Carney came in during the meeting and was called upon for a few remarks. He congratulated the association on the number present and said that although this was his first visit to the association, he intended to make a yearly pilgrimage to Massachusetts in the future.

At the conclusion of Mr. Carney's remarks, Mr. Carter presented State President, Eli Haworth, of Fall River, with a gavel. Mr. Haworth accepted the gavel, thanking the association for its kindness, and immediately took the chair. The first business was the appointment of the various committees for the facilitation of the business of the convention.

In the afternoon the delegates transacted routine business. The reports of the Secretary, Ole B. Peterson, of Boston, and Treasurer, Walter H. Damon, of Springfield, were read. The delegates then listened to an address by Arthur M. Hubbell, Second Vice-President of the International Union of Stationary Engineers, who spoke on "What the Legislative Committee of the State Body is Doing in Conjunction with the National Association Committee."

The convention voted to condemn the United States Civil Service Commissioners for the ruling that in the examination for an engineer of the Federal building in Chicago only graduates of a technical institution would be eligible. On account of a protest against the ruling, the examination, which was scheduled to take place June 26, has been held over. It was voted to forward resolutions, protesting against discrimination against non-technical engineers, to the President and Secretary of the treasury and to the Civil Service Commissioners. William H. Sennett,, Edward Cassity and J. H. Sumner were appointed a committee to draw up suitable resolutions.

After other routine business, the following officers were elected for the ensuing year: President, George E. Leavitt, Newburyport; Vice-President, Ole B. Peterson, Boston; Secretary, James H. Simmons, Cambridge; Treasurer, Walter H. Damon, Springfield. The officers were installed by National President Kelsey and National Vice-President J. F. Carney.

While the delegates were in session, the other members of the association gathered in the large hall, where they had plenty of time to examine the line of supplies that was on exhibition. The hall was filled with exhibits of engineering supplies and equipment and behind each booth was a representative of each firm ready to explain their exhibit.

The ladies who were present were entertained by the auxiliary of the local branch. A visit to Fairhaven was made where the various points of interest were visited.

The banquet was held on Friday evening and five long tables were used to accommodate the delegates and their friends. Previous to the dinner, which was served in seven courses, Elmer C. Horne, of the Entertainment Committee, extended a welcome to the gathering. He then announced that National Vice-President Carney was compelled to leave early in the evening and introduced him as the first speaker. Mr. Carney, after expressing his regret at being called away, spoke in a congratulatory way.

F. L. Johnson, of Lynn, acted as toastmaster for the after-dinner exercises. He first introduced National President T. N. Kelsey. President Kelsey said that if the National Association never performed any function but holding the Annual State Convention, its existence would be justified. He alluded to the isolated life of the engineer, and the fact that he is buried away in some building, seldom thought of except in case of an accident, and then not pleasantly. The President touched upon the educational aspect of the organization. The young man entering the life of an engineer to-day, he said, is forced to know more than was the case 25 years ago, and the steam engineer of the future will be a technical graduate.

On the subject of the right of every citizen to take a civil service examination, President Kelsey protested against disbarment for lack of a technical education. "It makes no difference where, when, or how we acquired our knowledge," he declared, "provided it is sufficient for us to pass the examination." President Kelsey said he hoped the New Bedford Association would increase in size and grow to a strength more in keeping with the number of steam plants in New Bedford.

Congressman William S. Greene was introduced as the next speaker. He spoke of the Civil Service Commission, and said that he was not aware that discrimination was being practiced against engineers. The speaker said he could see no reason for insistence on a technical education qualification for an engineer. "I believe," he declared, "there are enough members of Congress to correct the evil which your President has said exists. I have no question but that he is capable of so bringing the matter to the attention of Congress that the wrongs can be righted." The speaker called attention to the fact that throughout the country there was never such a demand for men and women who are willing to take up the work that their hands find to do.

Between the various speeches there was a liberal supply of humor and song, supplied by Edward Noonan, Thomas J. Whelan, Thomas Crowley and John Armour.

One of the most interesting speeches of the evening was made by Senator Wm. J. Bullock. Besides explaining what Massachusetts legislation has done for the engineer, the speaker dwelt on the fact that an engineer must often work on Saturady afternoon, making necessary repairs when the factory is closed down. A new law in this State which will redound to the benefit of the engineer, he said, is one that requires him to keep a record of the condition of his machines which shall be open to the inspection of the department having it under control. This will result in the proprietors of establishments being compelled to keep the machinery in good repair, and when the law is put into full operation, the engineers of the State will derive great benefit therefrom.

Past President P. H. Hogan spoke briefly of the history of the State Association. He stated that the association was organized at Fall River in 1896, and has since been growing all the time. He stated that the present gathering was probably the largest ever held by the association. In conclusion the speaker paid a tribute to the national organization, and its President.

**Delegates and Visitors to the Twelfth Annual Massachusetts State Convention of the N. A. S. E., New Bedford, Mass.**

State President Leavitt and Vice-President Peterson spoke briefly on the object of engineer organizations, after which the banquet wound up with the reading of a number of burlesque telegrams and songs and jokes by the entertainers.

Saturday sessions were devoted to visits of manufacturing plants, entertainment at the shops of the New Bedford Boiler and Machine Co., where a collation was served and a clam dinner at Fairhaven.

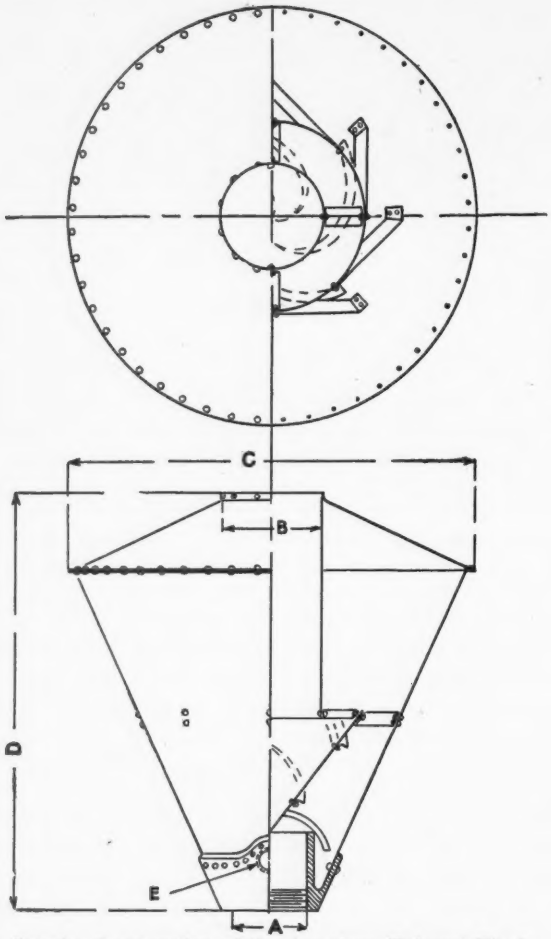
The local committees in charge of the convention were: Committee on Ways and Means, Frederic W. Carter, chairman; H. Percy Arnold, treasurer; George H. Comstock, Jr., secretary; James S. Fitts, John H. Parker, Arthur Tripp, Lawrence J. Crowell. Entertainment Committee, Frank G. Allen, John F. Riley, Elmer C. Horne.

The success of the convention, both in an educational and financial way was due to the following firms: Hart Packing

Co., Vilter Mfg. Co., Lagonda Tube Cleaner Co., Paterson Lubricator Co., Quaker City Rubber Co., McIntosh Seymour Co., British American Mfg. Co., Cling Surface Co., Lunkenheimer Co., Buhne Metal Packing Co., F. T. Akin Co., Green Economizer Co., McLeod & Henry Co., W. W. Tupper Grate Co., Morgan, Wright Co., N. B. Cordage Co., Garlock Packing Co., Mr. T. N. Kelsey, American Steam Gauge Co., Liberty Mfg. Co., Fraser Blower Co., Morse Twist Drill & Machine Co., The Biglow Boiler Co., Strong, Carlisle & Hammond Co., The Burke Engineering Co., Geo. W. Knowlton Rubber Co., Ashton Valve Co., Keystone Lubricating Co., Jenkins Bros., Gardner Grate Co., Steam Specialty Supply Co., Cancos Mfg. Co., Edward H. Carey, Babbitt, Wood & Co., Adam Cook's Sons, Eagle Oil & Supply Co., Arnold & Rankin, Williams Gauge Co., Geo. W. Lord Co., American Oil Co., A. W. Harris Oil Co., Wing Mfg. Co., Johns Manville Co., Power Specialty Supply Co., Bird Archer Co., American Boiler Economy Co., Henry K. Barnes, Spring Coal Co., New Bedford & Machine Co., Crosby Steam Gage & Valve Co., Mason Regulator Co., Philadelphia Grease Co.

### The American Exhaust Head.

There are two fundamental functions which all exhaust heads must perform; they must efficiently separate the moisture from the steam, and, at the same time, they must allow no back pressure to be put upon the engine. The American Exhaust Head, shown in the accompanying illustrations, embodies in its design and construction these desirable points, and, at the same time, it is made in such a form as to possess strength and durability.




Interior Construction of the American Exhaust Head

The exhaust steam from the engine passes upward, through the central pipe, and is deflected by a conical baffle plate in such a manner as to impart a whirling motion to it, thereby throwing the particles of water outward, the steam escaping through the center. The oil and water falls to the bottom and is piped off.

The American Exhaust Head

The interior of the exhaust head is so constructed that it presents a large surface for the condensation of the steam and ample volume for the separation of the moisture, which makes it efficient and noiseless in operation, and does not allow any back pressure on the engine. The exterior galvanized shell is made of heavy metal, the joints being securely riveted. The American Exhaust Head is manufactured by the Whitlock Coil Pipe Co., Hartford, Conn.

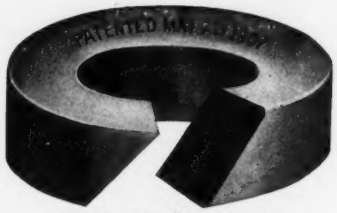
### Elastic Metallic Packing.

Since the first patent was granted for a packing in this country in 1862, there has been a gradual improvement in the design, construction and material used in packings which has been the result of experience in the many different uses to which packings have been subjected. As a result of many years experience, two practical engineers of Philadelphia have the honor of presenting to the engineering world a new improved metal packing for which a patent was granted on May 7, 1907. It is known as the Elastic Metallic Packing, and has been in constant use under all sorts of conditions for the past eighteen months.

As shown in the accompanying illustration, this packing consists of an interior of anti-friction metal which is held together by an outside flexible covering. This covering is a harmless composition and is simply used to hold the felted metal together until it is placed in the stuffing box, when the covering melts. This packing does not depend upon any lubricating material to keep down friction. It is

adapted to high speed engines, pump rods, piston rods and valve stems of every kind, and can be used on all kinds of engines, air compressors and valve stems. The packing can be used in any kind of stuffing box, as it requires no extra casing, springs or sleeves. It is generally made in the split ring form as shown, but can be made in any form desired for use.

When applying the elastic metallic packing, the stuffing box should be thoroughly cleaned. The ring is then opened enough to slip over the rod and is pushed in place with the gland. When the stuffing box is half filled, the gland is screwed up tight, after which it is slackened up and more packing added until the stuffing box is filled. The engine or pump is then started slowly for fifteen or twenty minutes, during which time the packing is kept perfectly tight by following up with the gland. After the packing is tight, no more adjustment is necessary.



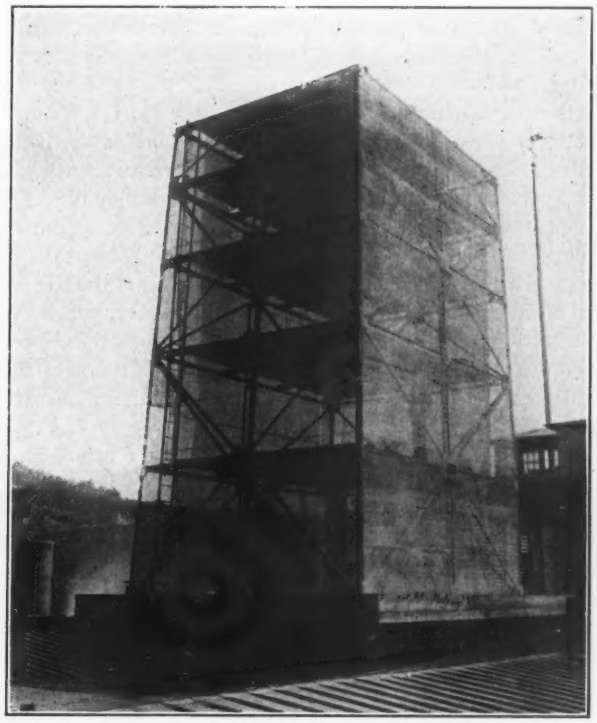
**Elastic Metallic Packing**

When removing the piston rod or valve stem, the rod may be pulled out and put back without disturbing the packing. The packing is guaranteed not to pulverize or become loose in the box, and it is claimed that no fragments or particles can go through into the cylinder. The Elastic Metallic Packing Co., 407 Cherry St., Philadelphia, Pa., are the manufacturers.

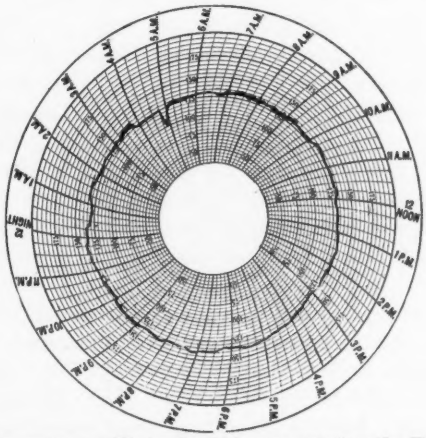
### The Burhorn Cooling Tower.

In any system or process where water is used to cool a surface or surfaces, a cooling tower can be used to reduce the temperature of the heated water to a point where it can again be used for its original purpose. This method becomes necessary in large cities, where the cost of water is high; in localities where the supply of water is scarce; or where the supply water contains sediment or salts in solution. A cooling tower will in general enable the work to be done with only about 5 to 10 per cent. of the water necessary without a tower and will remove a large per cent. of the impurities which otherwise would be deposited continuously on the cooling surfaces.

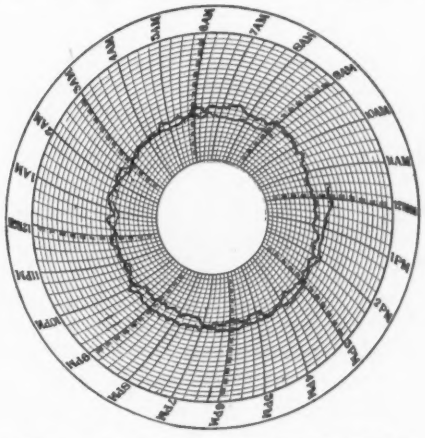
In order that the advantages of the cooling tower be obtained, the tower must be low in first cost, and the cost of maintenance and operation must be inappreciable. The loss in circulation water must be a minimum and the reduction in temperature should be as great as atmospheric conditions render possible. The accompanying illustration represents a Burhorn tower at the Home Brewing Co., at Shenandoah, Pa., which is designed and constructed with the above objects in mind. It is built throughout of steel and galvanized iron in such a manner that all parts are in plain sight and readily accessible. The water to be cooled flows or is pumped to the top of the tower and runs by gravity through the tower into a suit-



**Burhorn Cooling Tower at the Home Brewing Co., Shenandoah, Pa.**



**Temperature of Water for 24 hours entering the Tower**



**Temperature of Water Leaving the Tower**

able receptacle at the base of the tower when it is in condition to be used over again on the cooling surfaces.

This cooling tower is particularly adapted to plants where water is used for cooling purposes, such as for refrigeration, ice plants, steam engines, steam turbines and gas engines. In plants where water is used only on ammonia condensers, the range of cooling is necessarily limited. The temperature of the cooling water should at all times be as low as possible, as the high ammonia pressure increases with the increased temperature of this cooling water, and, as the refrigerating apparatus is called upon to do its maximum work in the hottest weather, the cooling tower must be designed to do its work under conditions of high temperature and high humidity. The accompanying charts represent those taken from a Burhorn cooling tower at the Keystone Ice Mfg. Co.'s plant, 11th and Dauphin Streets, Philadelphia. One chart shows the temperature of the water for 24 hours entering the tower, which averages about 130 degrees and the other chart shows the temperature of the same water leaving the tower, which averages about 55 degrees. This latter chart shows a record for almost 48 hours.

In gas engines, particularly in large sizes, the use of a pure and abundant supply of water is a necessity. The cylinders must be kept cool in order to allow the cylinder to become properly lubricated. A cooling tower for this work will not only allow the cooling water to be used over and over again, but by the use of water free from impurities will prevent the surfaces of the water chamber from becoming clogged with impurities. In large gas engine equipments, using producer gas, it is usual to use "scrubbers" to cleanse the gas before it passes to the engine. The water used in the scrubbers can be rensed after passing through a cooling tower.

The Burhorn cooling tower is particularly adapted for these purposes and is manufactured by Edwin Burhorn, 71 Wall Street, New York City.

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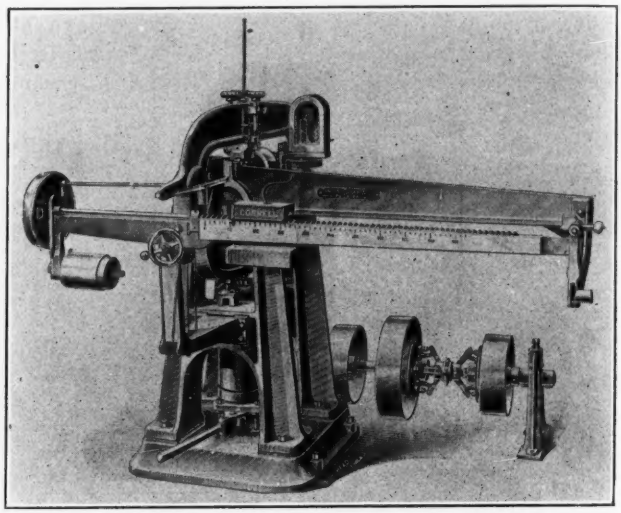
**Tests of Keystone Grease Made at Cramp's Shipyard.**

An interesting series of tests were recently made on Keystone Grease by the testing department of the William Cramp & Sons Ship & Engine Building Co., under the direction of Mr. C. R. Spare, chemist for the Cramp Co. The analysis as made by him shows that Keystone Grease, No. 1 Density, contains no free mineral acids, no rosin oil, no talc, graphite, clay, etc., and only 14 per cent. of free fatty acids. Also, that it was free from deleterious substances, such as would cause decomposition of the grease, or would injure metal surfaces.

The tests of the lubricating qualities of Keystone Grease were conducted upon the well known standard testing machine known as the Cornell Oil Testing Machine, which was designed and patented by Prof. R. C. Carpenter, of Cornell University, and which has been officially adopted by the United States Government as the standard device for testing lubricants.

The essential features of the testing machine, upon which the physical tests of the grease were made, is a journal revolved by belt and pulleys from the power shaft; the pressure upon the bearings may be regulated at will; a pressure indicator, which registers the load on the bearings; a speed indicator, to give the revolutions per minute; a thermometer, which registers the change in temperature of the journal and bearing as the test progresses; and a scale beam on which the frictional resistance is recorded. The coefficient of friction is found by dividing the frictional resistance by the total load on the bearings.

As all tests made for the coefficient friction are comparative, there were three tests conducted, one on each of two other greases and one on a sample of Keystone Grease, No. 1 Density. Each test was to have been conducted for one hour and thirty minutes and so far as possible. indentical conditions of speed, pressure, feed, etc., were to have been maintained. The readings were not begun until after thirty minutes running, in order that the bearings might have time to reach a constant temperature.



**Cornell Oil Testing Machine on which Keystone Grease Tests were Made**

The bearings were of standard shape, filled with Cramp's Government Babbitt and grooved diagonally. Grease was fed in each test, at a uniform rate, from a hand pressure cup of three ounces capacity, by applying a uniform pressure at five-minute intervals.

On the first grease tested, marked Letter "A," it was necessary on account of the high temperature, to discontinue the test before the expiration of the first hour. The journal had reached a temperature of 200 degrees Fahr., which caused the grease to smoke. During the latter part of the test, frequent additions of grease were made to keep the temperature at a safe limit, the friction during the latter part of the test fluctuating greatly. The result of this test follows: Pressure on journal, 1,500 pounds; area of journal, 14 square inches; pressure per square inch, 107.1 pounds; revolutions per minute, 450; average increase in temperature of the journal over the temperature of room, 96.2 Fahr.; average coefficient of friction, 0.01333.

On the second grease tested, marked letter B., it was impossible to test it at 1,500 pounds pressure, and on account of the regular increase in the temperature, the test was run at a pressure of 1,000 pounds for only thirty minutes. The result follows: Total pressure on journal, 1,000 pounds; area of journal, 14 square inches; pressure per square inch 71.4 pounds; revolutions per minute, 450; average increase in temperature over temperature of room, 86 Fahr.; average coefficient of friction, 0.0063.

The third test was made on Keystone Grease, Density No. 1. The whole test, which lasted 85 minutes, was characterized by the smooth running of the journal, the uniformity of its temperature, and the low coefficient of friction. There was no decomposition or residue left on the bearing. The result of the Keystone Grease test follows: Total pressure on journal, 1,500 pounds; area of journal, 14 square inches; pressure per square inch, 107.1 pounds; revolutions per minute, 450; average increase in temperature over temperature of room, 88.4 Fahr.; average coefficient of friction, 0.0056.

These three tests were made at the works of the Cramp Ship & Engine Building Co., and illustrate the value of lubricating greases. The coefficient of friction, when Keystone Grease was used, was 12½% less than with grease *B*, which stood only two-thirds of the pressure, and 137½% less than grease *A*, which was also subjected to 1,500 pounds.

In order to compare the lubricating properties of Keystone Grease with oil, a second series of tests were made by Mr. Spare on the same machine and with practically the same conditions as in the first test except that the pressure on the bearing was 3,000 pounds, being twice as much as in the previous test.

The first oil tested was Renown Engine Oil, which showed an average friction load in pounds of 12.06. Its coefficient of friction being 0.00427. The next oil tested was Vacuum Spindle Oil, which showed an average friction load of 13.7. Its coefficient of friction being 0.00457.

The test of Keystone Grease under the same conditions—3,000 pounds presure, showed a friction load of 10.2. Its coefficient of friction being .0034. Thus it is shown by this test that Renown Engine Oil possessed 26.2% greater frictional resistance than Keystone Grease, and that Vacuum Spindle Oil possessed 34.4% greater frictional resistance than Keystone Grease.

### Alaska Coal Fields.

Of the 600,000 square miles forming the Territory of Alaska, it is estimated that 12,644 square miles are underlaid by coal-bearing rocks—that is, rocks that probably contain coal seams—and that 1,238 square miles contain workable coal, ranging in age from Carboniferous to Tertiary and in composition from anthracite of good quality through high-grade semi-bituminous steam and coking coals and ordinary bituminous coal to lignites of various characters. Many of the known coal deposits are of great thickness, especially where the coal carries a large carbon content; but, unfortunately, high grade of coal and great thickness of beds are as a rule acompanied by geologic structure unfavorable to mining.

From the Pacific coast to Bering Sea and the Arctic slope, through the valleys of Copper and Yukon rivers and their tributaries, coal beds are widely distributed; and although it is unlikely that any except the high-grade coals of the Pacific Coast and the Matanuska and Bering River fields are suitable for shipment far from the mines, many others may be locally of extreme importance and great value.

The coal-mining industry of Alaska is still practically undeveloped, the total production for 1906—the year of greatest output—being 6,660 short tons, valued at $20.000. The most active mining operations have been on Cook Inlet, in southwestern Alaska, on the Yukon, in Seward Peninsula, and at Cape Lisburne, all undertaken to provide fuel for local use, by small coastwise or river steamers, at mining camps, and at canneries.

### Book Review.

"The Twentieth Century Toolsmith and Steelworker," by H. Holford. Size, 5 x 7½. 240 pages, 120 illustrations and 40 useful formulas. Published by Frederick J. Drake & Co., Chicago, Ill. Price, $1.50.

The making of tools, and the hardening and tempering of them have always been subjects of much interest to mechanics in all lines of trade, as it is usual to allow only certain men who are expert to perform this class of work. There are times, however, when it becomes expedient for the user of a tool to be able to forge or temper it himself, in which case he must take the experience of others as a guide. It was for this latter purpose that this book was written, and it contains what is said to be the results of hard work with hammer and tongs, deep study, years of experimenting and wide travel. Beginning with the methods of heating, forging, hammering, hardening, tempering, welding and annealing different kinds of steel, the book takes up the various instructions of how to forge, weld, anneal, harden and temper every tool that the toolsmith or toolmaker is called upon to make or repair, together with the various kinds and precautions which are necessary to make the particular operations successful.

The book is written with a brusqueness that characterizes the practical man and should prove useful to anyone having any tools or repairs to make.

### Crushed to Death by Flywheel.

Selecting a broad belt for a bed in the street railway power house at Hagerstown, Md., Oliver Sinnisen, a firemen, fell asleep and was crushed to pulp between the belt and large flywheel when the engine was started.

To polish brass, rub the metal with rottenstone and sweet oil, then rub off with a piece of cotton flannel, and polish with soft leather. A solution of oxalic acid rubbed over tarnished brass soon removes the tarnish, rendering the metal bright. The acid must be washed off with water and the brass rubbed with whiting and soft leather.

**The Handsome Display of Nonpareil Cork Pipe Covering and Insulating Materials Exhibited by John R. Livezey at the Master Car Builders Convention held at Atlantic City June 10th to 18th**

# TRADE NOTES

EDITED BY THE ADVERTISING MANAGER

Atlas Engines and Boilers are well known and used almost everywhere. Their economy and general excellence of construction are proven by their popularity. No steam user can make a mistake by purchasing them. On the second cover of this issue will be found a list of engines and boilers which the Atlas Company have now on hand, finished and ready for immediate delivery.

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The Perfection Grate Co., Springfield, Mass., have issued a new circular describing their shaking and chopping grate. This grate seems to be meeting with remarkable success. The guarantee of the company is strong, and judging from some of the testimonial letters which they receive, the grates must be making good.

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"Usudurian" sheet packing is said to be unequalled for joints that are so uneven as to require building up on one side, for the reason that it can be pieced or doubled up by applying a little naptha to the surface, so that under pressure it becomes as solid as one piece. Another feature of interest about "Usudurian" is that the scrap can be resold to the makers. A sample piece of Usudurian and illustrated catalog will be mailed to any engineer upon request. Address Revere Rubber Co., 71 Kingston Street, Boston, Mass.

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Messrs. Maurice Gesundheit and Henry Osgood have entered the unique field of Manufacturing Engineers and Business Methodizers. The firm's name is Gesundheit-Osgood Company, with offices at 43 Cedar Street, New York.

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Mr. Robert Gregory, of Pittsburgh, has accepted a position as district manager for the Pittsburgh Pneumatic Co.

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A complete detailed description of the new Elastic Metallic Packing advertised on the front cover of this issue is given in a booklet just issued by the Elastic Metallic Packing Co., 407 Cherry Street, Philadelphia, for free distribution to those who request it. An interesting feature about this new packing is the covering, which is a composition having a perfectly smooth surface and is without seams or rough edges.

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A planimeter is indispenable to every owner of an indicator. The Thompson Planimeter gives the M. E. P. of a diagram without figuring. Write for circular giving complete description and illustrations to Richard Thompson & Co., 126 Liberty Street, New York.

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The Cherry Chemical Co., manufacturers of the celebrated Red Seal Boiler Compound, 10 N. 19th Street, Philadelphia, reports that their business during the past six months has been more satisfactory than any six months during the past fourteen years.

They hope it is clearly understood by steam users that they manufacture compound only on an anyalytical basis. In other words, they make analysis of scale or water free of charge, and make a special compound for each particular case. Mr. Oliver Braden, the genial manager of this company, is still at the head and devoting his best energies to the interests of the steam using public.

Engineers sending their names and addresses will receive a beautiful ruler free.

The Canton-Hughes Pump Co., Canton, O., have published a 64-page booklet showing half-tone illustrations of some sixty different style pumps, compressors and condensers built by them. A copy will be sent to readers of THE PRACTICAL ENGINEER who request it.

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Mason & Ross, Northville, Mich., have received a letter from W. W. Van Dermark, Wilkes-Barre, Pa., stating that their Dillon Exhaust Steam Condenser is the best money saver he has ever run across. Mr. Van Dermark adds that with only a small condenser he has saved two tons of coal a week since installing it. At this rate the saving in a larger plant would be much greater. This apparatus seems to deserve a trial.

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Readers of THE PRACTICAL ENGINEER who are former residents of Buffalo, N. Y., are requested to send their present addresses to the Old Home Week Committee, Buffalo, in order to receive souvenir invitations to Old Home Week in Buffalo, which will be from September 1st to the 7th inclusive.

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The Terry Steam Turbine Co., of Hartford, Conn., have secured the order for eight 300 H. P. steam turbines for the new Waterside plant of the N.Y. Edison Co., 39th Street and First Avenue, New York City. These turbines are to be used direct connected to centrifugal pumps and are for boiler feed purposes. The capacity of each turbine pump unit, will be 1,000 gallons per minute, against a pressure of 300 pounds. This is probably the largest order for turbine driven centrifugal pumping machinery for boiler feed purposes ever placed. Some engineers have claimed that centrifugal pumps were not suitable for boiler feed purposes, but the N. Y. Edison Co., did not place this order until after they had used three of the Terry turbines for this same purpose for a year, so that the placing of this order is practical proof of the success of the Terry turbine driven centrifugal pump for boiler feed purposes.

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The American Goetze-Gasket & Packing Co., 725 East 141st Street, New York, has just put on the market a new cement, known as "Goetze's Cement," adapted for use on steam, gas and water pipe joints. It is plastic, having a putty-like consistency, and is therefore easily and quickly applied. It is claimed for it that it is of tough elastic firmness, withstands heat, cold and dampness, is not affected by acids, lyes, etc., and is non-poisonous. It is especially recommended for use with the well known Goetze's corrugated copper gaskets.

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The General Engineering Company has just completed a large contract at the McEwn Milk Company, 1515 26th Street, Philadelphia. The refrigeration plant has been completely overhauled, and they have installed a 50 H. P. Engine and one of the Gemmell Patent Boilers with smoke stack and connections complete. This boiler has given splendid satisfaction, as it is economical and a rapid steamer. This boiler is especially desirable in units up to fifty, or even one hundred horsepower and very inexpensive, requiring no setting and but little space, being of the vertical type.

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The Blackmer Rotary Pump, Power and Mfg. Co., of Petoskey, Mich., have opened an office in the machinery department of the Philadelphia Bourse.

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Some time ago Mr. A. C. Lippincott, Manager of the Indicator Instruction Co., Newark, N. J., offered as first, second and third prizes respectively, a Lippincott Indicator, Reducing Wheel and Planimeter, for the best answers to ten simple Indicator questions. These questions were sent particularly to those who claimed to be experts to whom therefore the Course of Instruction would be of no benefit. Although these questions were simple, and not a "catch" question among them, there was but one engineer in the United States and Canada who answered them all correctly, although there were over ten thousand sent out. The company announces that they will, in the near future, repeat the offer, with simpler questions, and that those who desire to compete should send for a list at once. The winners of the contest already decided were as follows: First Prize—J. O. B. Latour, 22 Adelaide Street, Toronto, Ont., Canada. Second Prize—Robert McLaren, 61 River Street, Toronto, Ont., Canada. Third Prize—Howard R. Lush, Huntsville, Ont., Canada.

The Indicator Instruction Co. announces a special offer of a scholarship with Indicator included, to those who can devote a little time to showing the instrument in their own city. Catalog and further particulars will be sent on request.

---

The Ireland Automatic Pipe Wrench probably beats the world for simplicity. It is shown on a circular and price list issued by the Ireland Pipe Wrench Co., 15 Court Square, Boston, Mass.

**100** Letter Heads, 100 Envelopes, and 100 Business Cards and Case, $1.50 postpaid Samples 2c. R. ELLIOT, Box 1376, St. Louis

**Wanted** Salesmen traveling among engineers to sell the France Metallic and Fibrous Packings. Good inducements on unoccupied territory, Address FRANCE PACKING Co., Tacony, Phila., Pa.

WANTED—Engineers and Mechanics to make big money selling O. K. Hand Soap. A 10-cent Can will instantly remove more dirt and stains from the hands than 4 cakes of any soap made, and it will not injure the most delicate skin. Small sample free. O. K. HAND SOAP CO., 570 Columbus Ave., Boston, Mass.

SLIDE RULES

F. F. Nickel, 150 Nassau Street, New York. Send stamp for reference slip containing valuable formulas.

A gilt edge proposition for a few travelling and erecting engineers. Address, Box 24, South Stillwater, Minn.

FOR SALE—A fully equipped machine shop, building steam engines and ice machines. Modern buildings, large grounds, and railroad siding. Plenty of orders ahead. Location eastern Pennsylvania. A good opportunity for a mechanical engineer. Box 8, The Practical Engineer, 46 N. 12th Street, Phila.

**PATENTS** Watson E. Coleman, Patent Attorney, Washington, D. C. Advice free. Terms low. Highest ref.

**PATENTS**
C. L. PARKER
Attorney-at-Law and Solicitor of Patents
Patents secured promptly and with special regard to the legal protection of the invention.
Handbook for inventors sent upon request.
186 Dietz Bldg., Washington, D. C.

ANY MACHINIST desiring a good set of books on modern machine shop practice, should have the "Rogers Library", consisting of three volumes; price $7.00, payable $1.00 a month. Complete catalog on request.
WRITE TO-DAY
THEO. AUDEL & CO., Pub.
63 Fifth Ave. New York

## The Cross Oil Filter

costs but a trifling sum a year to maintain—it renders used lubricating oil fit for use again and again. The oil is strained through waste and then washed in pure heated water, thus removing dirt and grit. *The more oil used, the greater the saving.*

## The Burt Exhaust Head

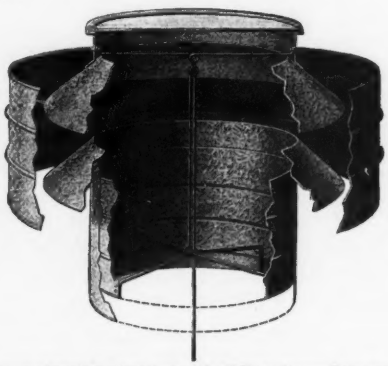
returns its cost through the prevention of costly repairs. It positively removes water and oil from exhaust steam lines—thus preventing injury to walls and roofs. Less fuel is required as condensation is returned direct to the boiler.

*Want the list of users?*

# Have You Sent For A Copy Of Our New 80-Page Catalog? It Is Free. To-day Is A Good Time To Write.

## The Burt Ventilator

*automatically* draws impure and hot air, smoke steam and gas out of the building, *without expense.* The cheapest and most practical ventilator in every way. *Its only cost is the first cost.*

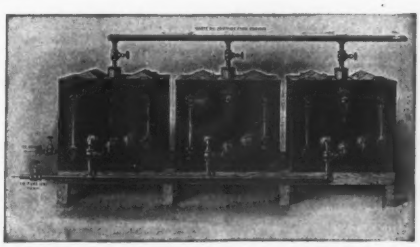


Sectional view showing glass top with sliding-sleeve damper patented.

By the use of our sliding-sleeve damper ventilator can be closed, yet the light is never shut off. The Stone & Webster Eng. Corp. have recently ordered 26-48 inch for power house.

## Burt Unit Oil Filters

will effect a saving of from 50 to 90 per cent of your "drip" oil, without impairing the lubricating qualities, return it pure, clear and ready for use again. *Isn't it worth while to cut oil bills in half?*



One or more Units can be operated together or separately as desired. An ideal filter for large plants. The Philadelphia Rapid Transit Co. have twenty-six.

**The Burt Manufacturing Company,** Largest Manufacturers of Oil Filters in the World
**204 MAIN ST., AKRON, O, U. S. A.**

ALSO SUPPLIED BY ENGINE BUILDERS, DEALERS AND POWER CONTRACTORS

The safety valve is one of the most important features of a power plant, yet strange to say, there are thousands of engineers who know very little about safety valves in general, or of any safety valve in particular. True most every engineer understands the old ball and lever valve, but to many, the pop valve, which is more generally used nowadays, is more or less of a mystery, consequently they are unable to discriminate between the good and the bad. The American Pop Safety Valve has some features of construction that are worth getting acquainted with. These features, together with cuts and diagrams, are shown in a large circular issued by the American Steam Gauge and Valve Mfgr. Co., 208 Camden Street, Boston, Mass. Ask for circular 23-P.

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The Jacobson Machine Manufacturing Company, Warren, Pa., have just issued Bulletin "C," which fully illustrates and describes their different types of gas and gasoline engines. A copy of this bulletin will be mailed free to any engineer interested in gas or gasoline engines.

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The Hershey Machine and Foundry Company, Manheim, Pa., have recently issued a separator booklet describing the Baum Separators. Those interested in steam and oil separators should write at once for a copy, as this separator has some distinctive features.

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The D. T. Williams Valve Company, of Cincinnati, has its 180-page catalog for 1907 ready for distribution. This handsome edition, better known as the "Williams Blue Book," illustrates and describes their complete line of high grade engineering appliances, a copy of which will be mailed free to any engineer. Those who have not yet written for a copy should do so at at once before the edition is exhausted.

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Another booklet, which has just been published by the D. T. Williams Valve Co., of Cincinnati, is devoted exclusively to the Williams regrinding valve, showing separate illustrations of each different part and explaining its purpose and its special merits. There are also several illustrations showing a man in the act of regrinding one of the valves and thus giving a perfect demonstration of the entire procedure. A copy will be mailed free to any engineer upon request. Address as above.

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In a recent interview with the editor of "Selling Magazine," Mr. Jas. L. Robertson told an interesting story about the success of Eureka Packing. Mr. Robertson is the man who made Eureka Packing! Or perhaps Eureka Packing made Mr. Robertson, like the sign in front of Boyle's Cafe. On one side it read "Dennis Boyle Keeps This Place," on the other side it read, "This Place Keeps Dennis Boyle." In any case, Eureka Packing has grown in a few years from a very small beginning to be a tremenduously big proposition in the packing world, and is known to every engineer who reads any one of at least forty trade journals.

In speaking of his troubles while proprietor of a knitting mill, and the difficulty of keeping a troublesome engine packed, Mr. Robertson told of the discovery of Eureka. He said:

"I had attached very little importance to the matter when, on complaining of our engine troubles to a house from which we bought raw materials, they recommended a packing they had been using, and sent me a small piece to try. They said it was the manufacturer's habit to make up two or three hundred pounds at a time and then travel about the country selling it. But it worked so well where other good packings had failed, that, as soon as I cleared myself of the knitting mill, I took a partner, a Mr. Hine, and arranged to handle it in connection with the damper regulator, starting on the road and making personal calls on power plant people in all parts of the United States and Canada."

Mr. Robertson is a friend of the operating engineer and a firm beiever in advertising. Concluding he said:

"You may say for me, and put it as strong as you like, that advertising, plus a good article, has made this business what it is by making that article known;—that advertising is building our big new plant over in New Jersey, just as it built a cosy place in the country where I am going to-morrow to put things in readiness for a comfortable summer; for, without advertising, none of our products, however good, would have won the wide reputation that has made the new plant necessary, and the summer home possible."

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Hicks' Ball Bearing Gland is a device which should find favor with every engineer who has had trouble with broken water glasses. With this arrangement no strain is allowed to come upon the glass. Two small metal rings, separated by a row of balls allow the gland to rotate without friction, and nothing touches the glass except the gasket, which gives enough play to allow for expansion and contraction. It is applicable on all forms of water gauges and, in a somewhat modified form, it is being used on ammonia piston rods, and compressor and steam rods of all kinds. A small catalog illustrating its method of application may be had by writing to Hicks & Timberlake, 3019 Broadway, St. Louis, Mo.

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Chas. C. Moore & Co., of San Francisco, Cal., are issuing a pamphlet entitled, "A Method for Calculating Steam Power Plant Economy." This pamphlet contains a comparison of economies with steam and elcetrically driven auxiliaries, initial cost of plant under Pacific coast conditions, and total cost of power with special reference to the use of oil fuel. It is a re-issue of their former power plant economy pamphlet to replace the supply lost in the fire, and will be sent to any reader of THE PRACTICAL ENGINEER upon request.

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A booklet concisely summarizing what a Cochrane Feed-Water Heater is and what it does is being distributed by the Harrison Safety Boiler Works, of Philadelphia. It shows that the Cochrane Open Feed-Water Heater will in many plants save about 16 per cent. of the coal bill, one-sixth of the water bill, improve the quality of the boiler feed supply, increase the capacity of the boilers by one-sixth, and supply hot water, not only for boiler feeding, but also for other purposes about industrial plants, as washing, dyeing, etc. Examples are given of practical applications at coal mines, paper mills, in condensing and non-condensing plants.

The Cochrane Oil Separators, which make it possible to use exhaust steam for every purpose to which live steam of the same temperature could be applied, as for heating and drying, are also described and illustrated.

No concern that is allowing exhaust steam to go to waste could fail to send for this pamphlet, and, to those who are interested, we understand the Harrison Safety Boiler Works will supply more detailed information relating to the special conditions involved, and showing the money saving to be expected in any particular plant.

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Demand for White Star Oil Filters continues to show no let-up, and this fact proves to the Pittsburg Gauge & Supply Co., Pittsburg, Pa., that prosperity still shows no signs of a let-up despite any statements to the contrary. Among those concerns who have purchased these filters during the past month are the following:

Walter Baker Co., Boston, Mass.; Union Ice Co., Quinnimont, W. Va.; Canton Home Brewing Co., Canton, O.; American Cast Iron Pipe Co., Birmingham, Ala.; Pittsburgh Buffalo Co., Burgettstown, Pa.; Anniston Fertilizer Co., Anniston, Ala.; Ivanhoe Furnace Co., Ivanhoe, Va.; Atlantic Suburban Electric Co., Atlantic City, N. J.; Taunton-New Bedford Copper Co., New Bedford, Mass.; Schenley Hotel, Pittsburgh, Pa.; West Virginia Brewing Co., Central City, W. Va.; Southern Steel Co., Ensley, Ala.; Crystal Laundry Co., Cumberland, Md.; Tenn. Coal, Iron & R. R. Co., Ensley, Ala.; Columbian Canning Co., Lubes, Me.; Flynn Lumber Co., Swiss, W. Va.; McGhee Lumber Co., Dallas, Fla.; Alton Packing, B. & F. B. Co., Alton, Ill.; Evansville Brewing Ass'n, Evansville, Ind.; John Westwick & Son, Galena, Ill.

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## AMORPHOUS GRAPHITE AS A LUBRICANT

BY H. C. WOODRUFF

Although the excellence of graphite for all sorts of lubrication and its particular adaptability to certain difficult lubrication is a matter with which most of us are familiar, few, perhaps, are cognizant of the fact that there are two forms of graphite—flake, or foliated, and amorphous, or nonstructural, graphite—and that though chemically the same the latter is capable of finer pulverization and with careful treatment may be reduced to an impalpably fine powder free from grit or harmful impurity.

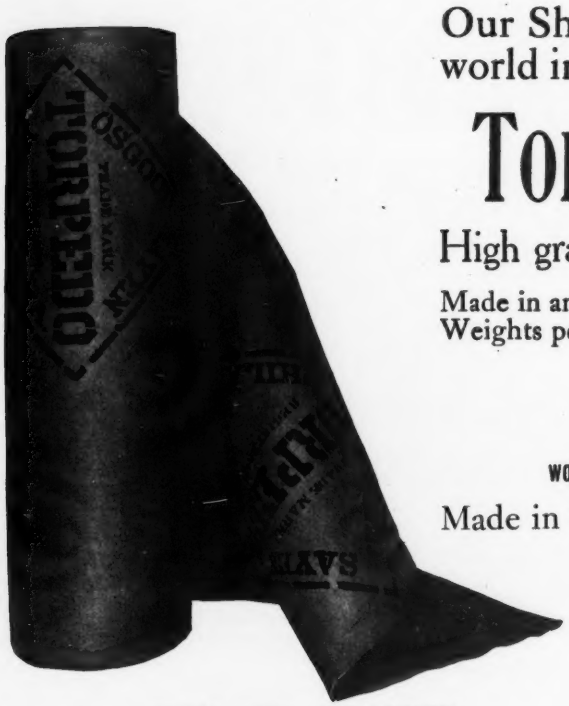
Amorphous graphite is adhesive. It stays put, and adhesiveness is one of the first requisites of an efficient lubricant in that to cool a hot bearing it is essential that the lubricating agent "stay put" where applied. To illustrate: Take a pinch of finely pulverized amorphous graphite and rub same in the palm of the hand, on paper or on some other convenient surface and observe its action. Note that the more one rubs the more effective the lubrication, for this form of graphite is not easily removed from surfaces and frictional contact, but maintains constant and effective duty right at the point of contact and is at its best under heavy frictional pressure. Then, too, as an impalpable powder it readily and quickly penetrates and distributes itself in a smooth, slippery, even coating between the tightest bearings, filling every pore, crevice and interstice, thereby evening irregular bearing surfaces.

A microscopic examination of perfectly smooth bearings—cylinder surfaces for instance—will disclose many minute irregularities, which, in the nature of things, must be productive of more or less friction. This friction of course means wasted energy—energy that instead of being utilized as power is absorbed as heat. To overcome this friction a lubricant possessing considerable "body" is required.

Experience has not only demonstrated that oil in itself will accomplish this only to a certain extent, but it has also taught that pure soft finely powdered graphite, properly and judiciously applied, will do wonders, so it only remains to make the proper application of the right sort of graphite.

This seemingly simple problem, however, is one that has until lately baffled engineers of experience, but it is now said that amorphous graphite when reduced to an impalpably fine powder will, when mixed with oil in the proportion of about one teaspoonful to the pint of oil, remain in perfect suspension long enough to feed through lubricator tubes without clogging, thus causing every drop of oil to carry its mite of graphite.

The United States Graphite Co., Saginaw, Michigan, prepares a lubricating graphite of this description.




TRADE MARK REGISTERED

Our Sheet Packings travel around the world in the largest ships of U.S. Navy

# Torpedo-Asbestos

## High grade RED RUBBER and Asbestos

Made in any thickness from one-thirty second inch up. Weights per square yard, as follows:—

1/32 in., weighs 4 pounds
1/16 in., weighs 6 pounds
1/8 in., weighs 10¼ pounds

WORKS EQUALLY WELL ON SUPER-HEATED STEAM LINES

Made in 100 lb. rolls, 40 inches wide. Used by U. S. Navy Dept., and one of the few sheet packings used and adopted as standard by the Navy Dept. Never fails to stand. Price per pound, 80c delivered. Used by all the shipyards in the U. S.

# Melville White Oxidized Sheet Gum Packing

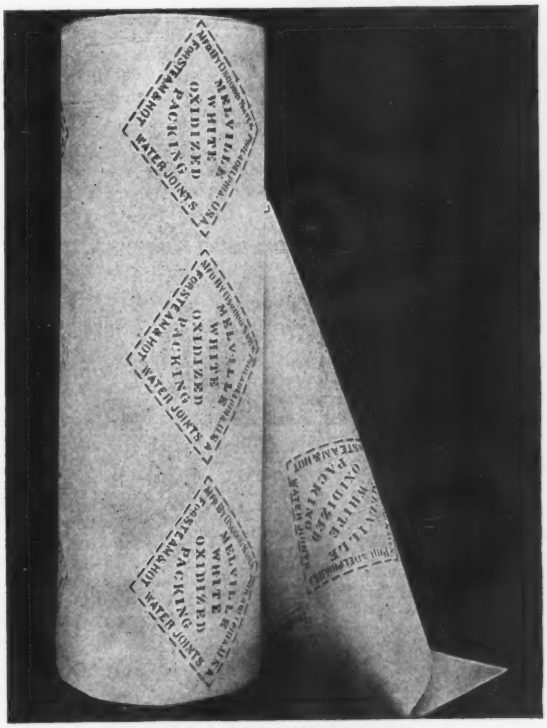
for hot water and steam joints. Will carry in stock in hot engine rooms for years without deteriorating. Has been on the market for 25 years. Nothing better for all-round work. Used by U. S. Navy Dept. for the last 15 years. Joints once properly made last indefinitely.

Soft, smooth finish made cloth insertion for hot water joints and low pressure steam.

Made brass wire gauze inserted for High Pressure Steam Joints.

Melville Brass Wire Inserted Sheet Packing is in use to-day on 180 lbs. steam pressure in marine service, and is giving better results than much more expensive packings on the market.

Send for samples.




TRADE MARK REGISTERED

**OSGOOD SAYEN**

**421 Arcade Building Philadelphia**

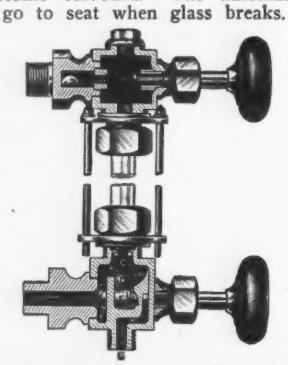
Fully illustrated 60-page catalogue just going to press. Get your name in and you will receive one.

"Saving Exhaust Steam Under Difficulties" is the title of a story published in circular form by the Harrison Safety Boiler Works, 3144 N. 17th Street, Philadelphia. It tells of some engineering practices in steel plants and of economical methods that have displaced wasteful practices of former times. It is entertainingly written and its suggestions will prove valuable to many readers.

The business conducted by and under the name of M. T. Davidson for the past twenty-five years, in the manufacture of steam pumps, condensers, etc., was recently incorporated under the name of M. T. Davidson Company. The incorporation causes no change in any way in the conduct of the business, the company consisting of Mr. Davidson and the heads of the several departments who have been associated with him for many years.

### A HIGH-CLASS AUTOMATIC WATER GAUGE.

Herewith we print a cut of what the makers say is the best "all round" Automatic Water Gauge on the market. The "Success" has many good points, several of which are of vital importance to users of water gauges. For instance, its Automatic devices will not stick or become corroded. The automatic balls must go to seat when glass breaks. Blow-



off is operated by gauge handle and seats of valve can be reground.

The objections to some automatic gauges are that the automatic devices go to their seats on the sudden opening or closing of blow-off or they become corroded, stick fast and do not operate at the critical moment. An examination of the "Success" gauge shows that these two objections are entirely overcome as will be seen from the following explanation.

"E" is a double seated valve to close both the gauge and the blow-off. It will be seen, therefore, that every time the lower handle is turned to blow off the gauge, the automatic device or ball "D" is moved by the stem on which it rests. In addition to this the steam follows the course of the arrows "B" to the outlet "G," creating a downward pressure on the ball "D" and rolling it about in the chamber in which it is located. This great agitation of this ball from three to six times a day prevents it from ever becoming limed up and stuck fast. When the glass breaks everything is reversed; the steam rushes upward to the break, creating a strong vacuum at the lower end of glass, when ball "D" is instantaneously raised to the location marked "C," when the flow of steam ceases. The upper ball is forced to its seat by pressure from boiler. The double seats of valve "E" can be ground by simply loosening the stuffing nut on handle.

The Penberthy Injector Company, of Detroit, Mich., who manufacture the "Success" and a large line of water gauges stand behind all claims they make for them.

The Lake Erie Boiler Compound Co., 198 Chicago Street, Buffalo, N. Y., will loan one of their automatic compound feeders free to every user of Red Star Boiler Compound. A circular describing the feeder will be mailed to any reader upon request.

The Parker Manufacturing Co., 8 Clifton Street, Boston, Mass., are manufacturers of all kinds of thermometers for mechanical uses. All of their thermometers are made with the dial face, which is decidedly preferable to the ordinary mercury column, especially for power plant purposes, such as finding the temperature of steam or hot water. A circular showing the many different styles made by this company will be sent by them to any address upon request.

## NEW POWER PLANTS AND IMPROVEMENTS

The Hoboken Land and Improvement Company, Hoboken, N. J., is constructing a large new heating and lighting plant. Henry L. Ebsen, architect.

The city council of Ogden, Utah, have decided to build a municipal lighting plant and are arranging to secure a water power site. The proposition in view is to take the water from the Ogden river in Ogden Canyon and pipe it to the point desired.

The city council of Crystal Falls, Mich., is going to build a large addition to the municipal power plant.

A new water power plant is being built by the Chippewa Valley Electric Railroad Company at Menominee, Wis. The work, which is now in progress, is the beginning of a water power development which will cost more than half a million dollars.

The Snow Mountain Electric Power Company of Willows, Cal., have recently incorporated and are going to build a hydro-electric generating power plant on the middle fork of Stony Creek.

The Cedar City Mills, Cedar City, Tenn., recently broke ground for the erection of their new power plant, which will furnish the whole town, as well as their own mills, with electric power. The company will erect a power house much larger than one actually needed for the present requirements in anticipation of an increased demand.

A large hydro-electric power plant, capable of developing 300,000 horsepower, is being built on the Stave river east of Vancouver, B. C. The promoters of this project, besides supplying power for the Great Northern Railroad, expect to supply power for commercial purposes in Puget Sound cities.

A new power house to furnish the electricity to operate the Guthrie and Oklahoma City street railway lines and the interurban now building, between the two cities, is to be built at Oklahoma City, Oklahoma.

A new municipal power plant furnishing the city with light and water is being built at New Hampton, Iowa, by Sheppard and Hutton, of that city.

The work of improvement on the power house of the Houghton County Electric Company, Houghton, Mich., is nearly completed and new machinery is being installed. One feature of the improvement is the rebuilding of the smoke stacks with an aim of reducing the smoke to a minimum.

The Escanaba Electric and Pulp Company have purchased all the water rights on the Escanaba river from the Gladstone bridge to a point below the old Flat Rock Dam, from the I. Stephenson Company, Menominee, Mich., and will shortly erect a large new power plant.

The foundation of the Edison Electric Illuminating Company's new power house at East Bridgewater, Mass., has just been completed. The power house will be of brick and steel, 60 x 200 feet, and will cost $200,000. Westinghouse, Church, Kerr Co., of Boston, Mass., are the engineers and contractors.

The Silica Stone Company is going to build a reinforced concrete, brick and stone power house at Sweedesford Road, Pa.

## SOCIETY NEWS

The Eighteenth Annual Convention of the Canadian Association of Stationary Engineers will be held in Guelph from the 13th to 15th of August, inclusive.

On Thursday evening, July 5th, Cement Association No. 4, of Pennsylvania, N. A. S. E. held their first annual banquet at the hotel Allen, Allentown. Cement Association has close on to one hundred members, all of which are employed by the Atlas Portland Cement Co. The company having shut down for the Fourth, intended to resume operations on the following day, but remained closed an extra day, so that the banquet could be held as arranged.

To the credit of the boys of No. 4, it can be said that every one who attended the banquet was at his post of duty on Saturday morning, jolly and ready for business, and the plant, which develops about 40,000 H. P. was started by 7.30 A. M. Cement Association has the unique record, as far as is known, of being the only association throughout the whole United States whose members are all employed by one company.

### CONVENTION OF BRITISH COLUMBIAN ASSOCIATION OF STATIONARY ENGINEERS.

The British Columbian Association of Stationary Engineers held their fourth annual convention at Vancouver, B. C. Delegates were present from each of the subordinate lodges throughout British Columbia and the convention was a complete success in every way. One of the chief features was a banquet tendered the visiting officers and delegates by the Vancouver lodge, at which covers were laid for one hundred and twenty-five guests. Witty and clever speeches, interspersed with good stories and excellent vocal and instrumental music, added to the enjoyment of all present. The tables arranged in horseshoe form were very prettily decorated, the floral effects being especially noteworthy. Several excellent addresses were made.

In proposing The Association, Mr. R. D. Sprague, grand secretary, delivered an eloquent speech. He reviewed the good work accomplished since its organization four years ago. His remarks were cheered to the echo.

Mr. Sprague threw a new and interesting sidelight on the duties of his fellow engineers.

"We started out on educational lines and have already done much to raise the status of our calling," said he. "The engineer occupies a position of great responsibility, even to a degree not appreciated by employers and the public. If our members are not reliable and respectable, life is imperilled and property is endangered. Our constant aim has been to make our engineers specialists in whatever special line they follow. Membership is growing very satisfactorily. Last year we enrolled forty-seven new names in the local association, while the lodges in Victoria and Nanaimo also show substantial gains. We have also striven to fully co-operate with the Government inspectors in enforcing the Inspection Act. Our interest has been shown by the amendments to the act we secured last session in the Legislature.

The following officers were elected: Grand chief, Arthur Manson, of Victoria, B. C.; grand vice-chief, Thomas Brown, of Nanaimo, B. C.; grand secretary, R. D. Sprague, of Vancouver, B. C., re-elected; grand treasurer, L. Fox, of Vancouver, B. C., re-elected, and F. N. Jones, of Victoria, B. C., doorkeeper.